FINAL

Light Nonaqueous-Phase Liquid Weathering at Various Fuel Release Sites

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base, Texas
San Antonio, Texas

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September 1999

PARSONS

Parsons Engineering Science, Inc. • A Unit of Parsons Infrastructure & Technology Group Inc.
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09 September 1999

Mr. Jerry Hansen
AFCEE/ERT
3207 North Road, Bldg. 532
Brooks AFB, Texas 78235-5363

Subject: Submittal of the Final Light Nonaqueous-Phase Liquid Weathering at Various Fuel Release Sites, September 1999 (Contract F41624-92-D-8036-0025)

Dear Mr. Hansen

Enclosed please find two copies of the September 1999 Final Light Nonaqueous-Phase Liquid Weathering at Various Fuel Release Sites. This report was prepared by Parsons Engineering Science, Inc. (Parsons ES) for the Air Force Center for Environmental Excellence Technology Transfer Division (AFCEE/ERT). The intent of this report was to determine rates of natural attenuation (weathering) of liquid nonaqueous-phase liquids (LNAPL).

The draft LNAPL weathering report was submitted to AFCEE in January 1999. Comments on the draft report were received from AFCEE as reviewed by Mr. Daniel Kraft of the Waste Policy Institute (WPI) in San Antonio, Texas, and Mr. Jon Atkinson of the Consultant Operations Division. Responses to these comments were prepared by Parsons ES and are attached to this letter.

If you have any questions or require additional information, please call me at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Bruce M. Henry

Bruce M. Henry, P.G.
Project Manager

Enclosures

cc: Don Kampbell – USEPA NRMRL
File 729691.35000

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Responses to AFCEE Comments on the Draft Light Nonaqueous-Phase Liquid Weathering at Various Fuel Release Sites

A. RESPONSES TO MR. KRAFT'S COMMENTS:

I. General Comments and Parsons ES Responses:

1. Clarity and Organization

The document is well organized and easy to follow. The investigative work and the rationale and equations used to study the effects of the various weathering mechanisms for each of the fuel hydrocarbons in the study (gasoline, JP-4, JP-5, and JP-8) are clearly presented.

Parsons ES Response:

No Comment.

2. Completeness

The document is generally complete and provides a thorough yet concise summary of the literature review conducted and the chemistry and compositional makeup of the fuel hydrocarbons evaluated in the study. A table at the end of Section 6 summarizing the findings of the study and comparing them to the range of values currently in use would be helpful.

Parsons ES Response:

A table will be added to Section 6 that summarizes the BTEX weathering rates observed for JP-4 and JP-8 mobile LNAPLs. Because BTEX weathering rates for JP-5 and gasoline mobile LNAPLs could not be meaningfully determined based on study results, no data will be presented for these fuel types.

3. Technical Issues

Weathering of petroleum fuels in the subsurface environment is affected by numerous physical and chemical processes that exhibit a high degree of variability within a given fuel type, from one site to another, and spatially within each site. Moreover, the accurate measurement of many of these variables is difficult and laboratory derived values often deviate significantly from those observed in the field. This requires the use of a range of possible values and the selection of the most conservative value for defensibility. When multiple parameters derived in this fashion are used to calculate LNAPL contaminant depletion rates, accuracy is diminished and the results may be too conservative.

Overall, the study was only moderately successful at improving the scientific basis and defensibility for determining natural LNAPL weathering rates. BTEX weathering rates for gasoline, JP-5, and JP-8 (three of the four fuel types investigated) were indeterminate. The

report does provide some empirical justification for using the lowest depletion rate from the range of values determined for JP-4.

Parsons ES Response:

During development of the work plan for this fuels weathering study, the primary fuel types of interest were JP-4 jet fuel and gasoline. JP-5 and JP-8 fuel release sites were later added to the study when it became apparent that insufficient JP-4 and gasoline sites were available that met the original site selection criteria. While BTEX weathering rate data for the JP-5 and gasoline release sites was indeterminate, mobile LNAPL BTEX weathering at the one JP-8 site strongly corroborates BTEX weathering rates observed at JP-4 sites with similar hydrogeologic conditions (sandy soils and high groundwater velocities).

II. Specific Comments with Responses:

Item 1 – Page 2-22, Para 1:

The text states that under nonequilibrium conditions the dissolution rate cannot be enhanced by advection or biodegradation that further reduces the aqueous concentration. This implies that for aqueous concentrations less than the equilibrium concentration, the dissolution rate is constant irrespective of the aqueous concentration (i.e., the dissolution rate is linear below equilibrium concentrations). WPI recommends verifying that this is correct and rewrite the text, if necessary.

Parsons ES Response:

No revision of the text is required. The suppositions drawn by the reviewer cannot be supported by information obtained during the literature search. The findings presented by Seagren et al. (1993) are correctly referenced and no corrections are warranted.

Item 2 – Page 2-25, Para 1, Line 1

The text states that biodegradation of dissolved petroleum contaminants reduces aqueous contaminant concentrations and thereby enhances dissolution rates. This appears to be inconsistent with the statement made on page 2-22 that dissolution rates cannot be enhanced by biodegradation (see Comment 1). WPI recommends clarification.

Parsons ES Response:

The referenced statement on Page 2-22 refers to dissolution under nonequilibrium conditions. If equilibrium conditions exist, biodegradation of dissolved petroleum contaminants will reduce aqueous concentrations and enhance dissolution rates. The referenced sentence will be modified to state specifically that dissolution is enhanced by biodegradation under equilibrium conditions.

Item 3 – Page 2-26, Para 4, Line 1

The use of the term "interphase" do describe the transition zone is unclear. Rewrite the text for clarity.

Parsons ES Response:

The word "interface" will be used in place of "interphase" at the referenced location.

Item 4 – Page 2-29, Para 2, Bullet 2

Replace "Oil-mass rates" with "Oil-mass loss rates."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 5 – Page 2-29, Para 2, Bullet 3

It would seem intuitive that 10 years of data would provide a more accurate decline curve depicting mass loss rates. Provide more detail concerning the "speculative" nature of the yearly data to demonstrate why this was an important conclusion of the study.

Parsons ES Response:

Parsons ES concurs. The referenced conclusion was not an important finding of the Landon and Hult (1991) study; and as a result, it will be deleted from the final report.

Item 6 – Page 2-31, Para 3, Line 2

For clarity, replace "benzene+toluene/ethylbenze+xylenes" with "(benzene+ toluene)/(ethylbenzene+xylenes)" and replace "B+T/E+X" with (B+T)/(E+X)," In addition, replace all instances of these expressions.

Parsons ES Response:

Parsons ES concurs. The requested changes will be made.

Item 7 – Page 5-3, Para 2, Line 9

As punctuated, the sentence implies that all of the JP-4 sites were older than 20 years. For clarity, replace "at JP-4 sites, where fuel releases" with "at JP-4 sites where fuel releases."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 8 – Page 5-6, Para 3, Line 2

Replace "the amount of contaminant depletion" with "the rate of contaminant depletion."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 9 – Page 6-1, Para 1, Line 10

Replace "inflate long-term monitoring and site management costs" with "inflate projected long-term monitoring and site management costs."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 10 – Page 6-2, Bullet 6

It is not clear if the statements provided reflect findings of the study or are suppositions that should be located in Section 2 of the report. Provide study results that support this finding.

Parsons ES Response:

Data collected from the DFSP-Charleston site and the Offutt AFB site support the finding presented. Varying mobile LNAPL weathering rates were observed at both these sites likely as a result of sample location within the LNAPL plume. A reference to the results from these two study locations will be added to the text.

Item 11 – Page 6-3, Bullet 2

For clarity, replace "estimating total BTEX weathering from LNAPL" with "estimating total BTEX weathering from JP-4 LNAPL."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 12 – Page 6-3, Bullet 4

For clarity, WPI recommends replacing "estimating benzene weathering from LNAPL" with "estimating benzene weathering from JP-4 LNAPL."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

RESPONSES TO MR. ATKINSON'S COMMENTS:

Item 1 – Page 1-3, Sec 1.1, Bullet 4

In line 3, suggest replacing "geology" with "soils."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 2 – Page 3-2, Sec 3.1, Para 1, Sent 4

Are JP-5 and JP-8 reversed? In other words, should JP-5 be linked to 0.40 wt% and JP-8 associated with 0.05 wt%?

Parsons ES Response:

JP-5 and JP-8 are not reversed. The associated weight percentage for both JP-5 and JP-8 were obtained from Figure 2.3.

Item 3 – Page 3-3, Sec 3.1, Para 1, Sent 4

To correct terminology, "groundwater tables" should be changed to "water tables."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 4 – Page 4-4, Sec 4.2, Line 1

Suggest inserting "to" after "order."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Responses to AFCEE Comments on the Draft Light Nonaqueous-Phase Liquid Weathering at Various Fuel Release Sites (Continued)

Item 5 – Page 5-8, Sec 5.2.2

In the definition of "e," suggest rounding this value to 2.72 to be consistent with the use of "approximately."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 6 – Page 5-25, Sec 5.2.4.1, Para 1, Line 6

Recommend deleting "the" following "that."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 7 – Page 5-27, Sec 5.2.5.1, Line 3

Suggest inserting "the" in front of "mobile."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

Item 8 – Page 5-43, Sec 5.4.2, Para 2, Sent 2

My inspection of Figure 5.17 reveals a loss of "lighter" BTEX compounds but retention of "heavier" hydrocarbons. If this is so, suggest revising this sentence as follows: "...little residual LNAPL BTEX compounds remain in soils..."

Parsons ES Response:

Parsons ES concurs. The requested change will be made.

FINAL

LIGHT NONAQUEOUS-PHASE LIQUID WEATHERING AT VARIOUS FUEL RELEASE SITES

September 1999

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

TECHNOLOGY TRANSFER DIVISION

BROOKS AIR FORCE BASE

SAN ANTONIO, TEXAS

Prepared by:

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ACRONYMS AND ABBREVIATIONS

%/yr	Percent per year
°C	Degrees Celsius
AD Little	Arthur D. Little
AFB	Air Force Base
AFCEE/ERT	Air Force Center for Environmental Excellence/Technology Transfer Division
AST	Aboveground storage tank
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
DFSP	Defense Fuel Supply Point
DoD	Department of Defense
EAL	Evergreen Analytical Laboratory
GC/FID	Gas chromatography/flame ionization detection
GC/PID	Gas chromatography/photoionization detector
JP-4	Jet Petroleum No. 4
JP-5	Jet Petroleum No. 5
JP-8	Jet Petroleum No. 8
K_{fw}	Fuel/water partitioning coefficient
LNAPL	Light, nonaqueous-phase liquid
MCAS	Marine Corps Air Station
MCL	Maximum contaminant levels
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mg/mL	Milligrams per milliliter
μg/L	Micrograms per liter
μg/mL	Micrograms per milliliter
NAS	Naval Air Station
NRMRL	National Risk Management Research Laboratory
PAH	Polynuclear aromatic hydrocarbons
Parsons ES	Parsons Engineering Science, Inc.
R^2	Coefficient of determination
RNA	Remediation by natural attenuation
SVE	Soil vapor extraction
TMB	Trimethylbenzenes
US	United States
USAF	US Air Force
USEPA	US Environmental Protection Agency
USN	US Navy
UST	Underground storage tank
vol%	Percent by volume
wt%	Percent by weight

SECTION 1

INTRODUCTION

This report, prepared by Parsons Engineering Science, Inc. (Parsons ES), presents the results of work completed to evaluate natural weathering of light nonaqueous-phase liquids (LNAPLs) resulting from petroleum releases to the subsurface environment. As part of the natural attenuation demonstration project (Contract No. F41624-92-D-8036, Delivery Order 25), the Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT) contracted with Parsons ES to perform this fuels weathering study. Of particular interest for this study is the weathering or natural depletion of benzene, toluene, ethylbenzene, and xylenes (BTEX) from free-phase product (i.e., mobile LNAPL) following a fuel release. The BTEX compounds typically are identified as fuel hydrocarbon contaminants of concern because of their solubility and resulting mobility in soil and groundwater, and their relative toxicity (especially for benzene). Of primary interest for the study were jet petroleum no. 4 (JP-4) and gasoline release sites because they are the most common fuels on Air Force installations and have high initial BTEX fractions. However, spill sites with lower initial BTEX fractions, such as JP-5 and JP-8, also were evaluated.

1.1 PROJECT SCOPE AND OBJECTIVES

At many government and commercial sites, large-volume environmental releases of jet fuel or gasoline have contaminated and continue to contaminate soil and groundwater systems. Primary sources of large-volume fuel releases include fuel handling and storage activities associated with aboveground storage tanks (ASTs), underground storage tanks (USTs), fuel pumphouses, fuel hydrant systems, oil/water separators, and fuel pipelines. Uncontrolled catastrophic or chronic releases from such a source can result in large volumes of fuel being released to the subsurface. In the subsurface, the LNAPL often is present both as residual and mobile contamination. Residual LNAPL is defined as the LNAPL that is trapped in the aquifer by the processes of cohesion and capillarity, and therefore, will not flow within the aquifer or from the aquifer matrix into a groundwater well under the influence of gravity. Mobile LNAPL is defined as LNAPL that is free to flow in the aquifer and will flow from the aquifer matrix into a well under the influence of gravity.

The purpose of this study is to improve the scientific basis of and defensibility for determining natural LNAPL weathering rates (i.e., contaminant source-term reduction rates) as a component of remediation by natural attenuation (RNA). Currently, little information is available regarding rates of natural weathering of the BTEX components from mobile fuel LNAPLs. As a result, the rate of reduction of the contaminant source term in groundwater models often is left to professional judgment. The use of overly conservative LNAPL weathering rates to evaluate contaminant fate and transport and

the suitability of RNA as a remedial alternative can extend the estimated timeframe for long-term monitoring and affect the estimated cost-effectiveness and administrative feasibility of implementing RNA. Conversely, overestimation of weathering rates can lead to an overly optimistic forecast of RNA performance.

The primary objective of this fuel weathering study was to document a range of BTEX weathering rates for the mobile LNAPL fraction based on data collected from sites with documented mobile LNAPL plumes with known release dates. In addition, rates of naphthalene and methylnaphthalenes weathering from mobile LNAPLs were evaluated. Secondary objectives of this study included an evaluation of the degree of contaminant partitioning of BTEX from mobile LNAPL to groundwater, and comparison of weathering effects on the mobile LNAPL fraction and on residual LNAPL present in capillary fringe soils. The following tasks were completed to meet these objectives:

- A literature search to assess existing information regarding weathering of LNAPLs;
- Selection of eight primary sites where the time of release is generally known and free-phase jet fuel or gasoline remain *in situ*;
- Sampling of soil, groundwater, and free-phase LNAPLs at the primary sites;
- Evaluation of data obtained from the eight primary sites, as well as data from four secondary sites, to assess contaminant concentrations in site media in relation to such factors as age of the fuel release, fuel type, and site soils and hydrogeology.

This technical report summarizes the findings of the literature review and provides an assessment of site-specific mobile LNAPL weathering rates.

1.2 REPORT ORGANIZATION

This technical report consists of seven sections, including this introduction, and three appendices. Section 2 presents pertinent background information and findings from the literature review. Section 3 presents site selection criteria and a listing of the sites selected for the study. Section 4 summarizes the procedures used for collection and analysis of the site data. Section 5 summarizes the analytical results and presents the results of the LNAPL weathering data analysis. Section 6 presents conclusions based on the study results, and Section 7 lists the references used in preparing this document. Appendix A provides a copy of the original work plan and site addenda. Appendix B provides the analytical data for LNAPL, soil, and groundwater samples collected at the study sites. Appendix C provides calculations from the data analysis.

SECTION 2

LITERATURE REVIEW

The purpose of the literature review was to compile and summarize available technical literature on natural weathering of the BTEX fraction of fuel LNAPLs released to the subsurface environment. Specifically, the literature search attempted to answer the following question:

> Is there sufficient scientific information available regarding *in situ* weathering rates for BTEX in mobile LNAPL to refine modeling assumptions used to predict reductions in the contaminant source term at fuel-hydrocarbon-contaminated sites?

Parsons ES experience with the AFCEE natural attenuation demonstration project had indicated a lack of scientifically defensible information regarding BTEX weathering rates for mobile LNAPL. As a result of this data gap, weathering rates used to simulate BTEX source terms in fate and transport modeling generally have been based on professional judgment and consideration of site-specific conditions. Typically, total BTEX depletion rates (i.e., contaminant source-term reduction rates) between 1 and 15 percent per year (%/yr) have been assumed. Site-specific conditions such as groundwater depth, precipitation, composition of the soil/aquifer matrix, and site location also have been considered in determining whether BTEX removal from mobile LNAPL is likely to be hindered or enhanced. For example, a total BTEX depletion rate between 10 and 15 %/yr might be assumed for a high-precipitation, high-soil-permeability, shallow groundwater site in Florida; whereas a depletion rate of 1 to 3 %/yr total BTEX might be assumed for a low-precipitation, low-permeability, deep groundwater site in Montana. Where site conditions do not appear to excessively hinder or enhance BTEX depletion from mobile LNAPL, a default value of 5 %/yr often was used. No scientific studies were known to exist that could support the validity of these assumptions. Therefore, a more formal literature search was included as part of this study.

A preliminary review of the literature as summarized in the work plan (Appendix A) indicated that there was not sufficient information regarding BTEX weathering rates in mobile LNAPL, and that field studies of fuel-contaminated sites would be appropriate. Since the time of the initial literature review, additional information regarding weathering processes and rates of fuel weathering has been gathered; however, the general findings of the preliminary literature review remain the same. No field studies were identified that scientifically evaluate naturally occurring BTEX reductions (weathering) within mobile LNAPLs at fuel release sites. A discussion of fuels composition and a review of the fuel weathering literature is provided in the following

subsections as background information for the fuel weathering study results and conclusions presented in Sections 5 and 6, respectively.

2.1 GASOLINE AND JET FUEL USE AND COMPOSITION

2.1.1 Fuel Use and History

Gasoline, diesel fuel, and jet fuel represent the primary fuel types used at United States (US) military installations for powering vehicles, equipment, and aircraft. Large-volume storage and handling of these petroleum products has resulted in widespread environmental contamination of soil and groundwater. However, BTEX contamination of soil and groundwater at US military installations has resulted primarily from uncontrolled releases of gasoline and jet fuel.

A variety of jet fuels have been used for powering US military aircraft turbine (jet) engines since the beginning of jet flight in the 1940s. Since the 1950s, JP-4 and JP-5 represent the primary fuels used by the US Air Force (USAF) and US Navy (USN), respectively. More recently, the USAF has converted from JP-4 to JP-8 because of the lower volatility and lower explosion/fire hazard of JP-8. In 1979, USAF installations in Great Britain replaced JP-4 with JP-8 (Martel, 1987), and in 1993/1994, USAF installations in the continental US converted to JP-8. Therefore, most JP-8 fuel releases that have contaminated soil and groundwater at USAF installations are no more than 5 years old. While other jet fuels have been used by the US military, their use and storage has been limited, resulting in far less environmental site contamination from these less common fuels.

2.1.2 Hydrocarbon Composition of Gasoline and Jet Fuel

Gasoline and jet fuel are refined petroleum products derived from crude oil. Crude oil, a degradation product of organic material (e.g., prehistoric animal and plant matter) is a complex mixture primarily composed of hydrocarbons, which are compounds consisting solely of carbon and hydrogen. Measured by weight, carbon and hydrogen represent at least 95 percent of the elements present in crude oil (Neumann *et al.*, 1981). In comparison, hydrocarbon concentrations in refined petroleum products such as gasoline, diesel fuel, and kerosene are even higher than in crude oil, because non-hydrocarbon compounds (which contain sulfur, nitrogen, oxygen, or trace metals) are destroyed or removed during the refining process (Owen and Corey, 1990).

2.1.2.1 Distillation

The hydrocarbon composition of gasoline and other petroleum products derived from crude oil is largely determined during the refining process known as distillation. Distillation is a process whereby the crude oil is heated/boiled, and fractions of the crude oil are separated based on boiling point. During distillation, the more volatile, shorter-chain, lower-molecular-weight hydrocarbons are initially removed at relatively low boiling points, and the less volatile, longer-chain, heavy-molecular-weight hydrocarbons are subsequently removed at higher boiling temperatures. Distillation utilizes the relationship between boiling point and hydrocarbon molecular weight to separate crude oil into useable fractions, or "cuts," for further refinement into petroleum end products. Because hydrocarbon molecular weight is dictated by the

number of carbon atoms present, it is possible to generally classify these distillation cuts by their predominant carbon-atom ranges (American Society for Testing and Materials [ASTM], 1995):

- Gasoline - C_4 to C_{12} hydrocarbons;
- Kerosene and jet fuels - C_{11} to C_{13} hydrocarbons;
- Diesel fuel and light fuel oils - C_{10} to C_{20} hydrocarbons;
- Heavy fuel oils - C_{19} to C_{25} hydrocarbons; and
- Motor oils and other lubricating oils - C_{20} to C_{45} hydrocarbons.

2.1.2.2 Wide-Cut and Kerosene-Based Jet Fuels

Jet fuels commonly used by the Air Force and Navy can generally be separated into two categories: "wide-cut" fuels and "kerosene-based" fuels (Martel, 1987). JP-4 is created by taking a "wide cut" of the distillate to include both the gasoline and kerosene fractions. JP-4 typically is composed of approximately 50 to 60 percent gasoline and 40 to 50 percent kerosene (Martel, 1987). This large percentage of gasoline imparts increased volatility to JP-4. On the other hand, JP-5 and JP-8 are kerosene-based fuels that contain relatively less volatile, longer-chain hydrocarbons.

2.1.2.3 Hydrocarbon Structure

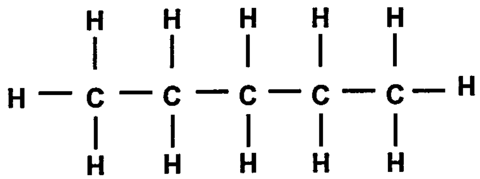
The three most prevalent types of hydrocarbons in crude oil and refined petroleum products, based on their chemical structure, are alkanes, alkenes, and aromatics. Figure 2.1 illustrates the structures of these three types of hydrocarbon compounds.

Alkanes, or paraffins, are hydrocarbon chains characterized by single molecular bonds between the carbon atoms and "saturation" of all remaining bonding sites by hydrogen atoms. For this reason, alkanes also are referred to as saturates. Based on their structure, alkanes can be further separated into n-alkanes (straight-chain alkanes), isoalkanes (branched-chain alkanes), and cycloalkanes (alkane rings) (Figure 2.1). Isoalkanes and cycloalkanes are commonly referred to as isoparaffins and naphthenes, respectively. In general, alkanes are the most abundant hydrocarbons in crude oil and gasoline. Alkanes represent 55 to 75 percent of all hydrocarbons in crude oil (Metcalf & Eddy [M&E], 1993). A compilation of analytical results from 10 gasoline samples indicated that alkanes make up approximately 55 percent by weight (wt%) of the hydrocarbons in gasoline (Nakles *et al.*, 1996).

Alkenes, or olefins, are characterized as hydrocarbon chains that are not saturated with hydrogen atoms, and as a result, contain one or more double bonds between carbon atoms (Figure 2.1). While alkenes are typically at trace levels in crude oil, their concentration in petroleum products is often increased by the refining process. Nakles *et al.* (1996) reported the concentration of alkenes in gasoline as approximately 11 wt%.

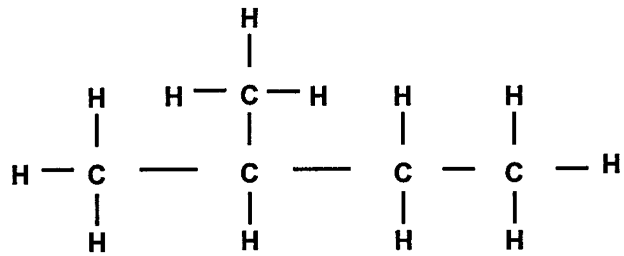
ALKANES

n- Alkane Structure



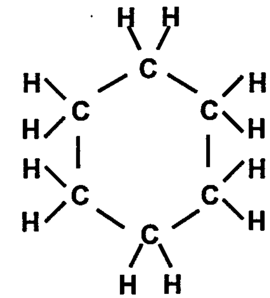
C_5H_{12}
(n-Pentane)

Isoalkane Structure



C_5H_{12}
(2-Methlybutane)

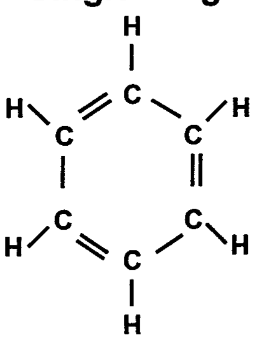
Cycloalkane Structure



C_6H_{12}
(Cyclohexane)

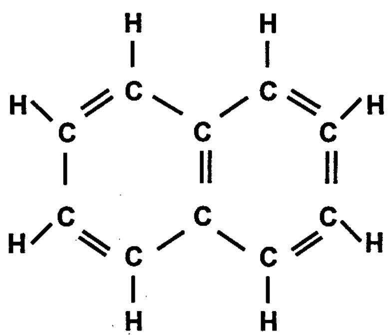
AROMATICS

Single-Ring



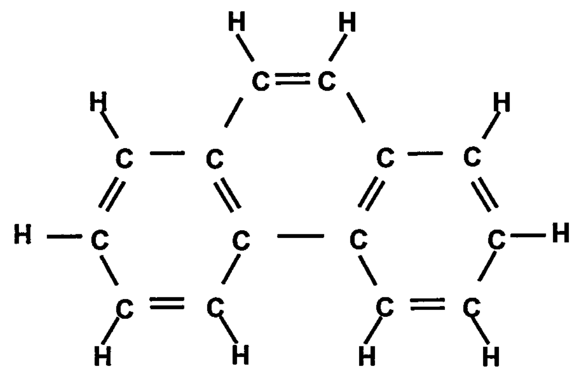
C_6H_6
(Benzene)

Two-Ring



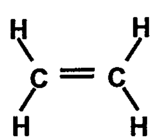
$C_{10}H_8$
(Naphthalene)

Three-Ring



$C_{14}H_{10}$
(Phenanthrene)

ALKENES



C_2H_4
(Ethylene)

FIGURE 2.1

TYPICAL STRUCTURES OF FUEL HYDROCARBONS

Fuel Weathering Study

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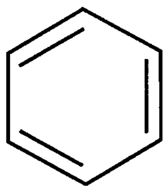
Aromatic hydrocarbons also are unsaturated, and are characterized by their six-carbon ring structure. As illustrated on Figure 2.1, the six-carbon-ring aromatic structure has alternating single and double bonds. The simplest aromatic compound is benzene (C_6H_6), which is composed of a single aromatic ring (monoaromatic). Benzene and its chemical derivatives are common in volatile fuels such as gasoline and JP-4. Other aromatic hydrocarbons more typical of heavier, less volatile fuel types are naphthalene, a two-ring aromatic (diaromatic) and phenanthrene, a three-ring aromatic (Figure 2.1). Three-ring and higher aromatics are often referred to as polynuclear aromatic hydrocarbons (PAHs). Nakles *et al.* (1996) reported that aromatics make up approximately 33 wt% of the hydrocarbons in gasoline. However, in jet fuels, the aromatic content is limited to no more than 25 percent by volume (vol%) to improve combustion performance and minimize solvent effects (Martel, 1987).

A common feature of petroleum-derived aromatics is the presence of an "alkyl" group in place of a hydrogen atom on the six-carbon ring. Common alkyl groups are the methyl group and the ethyl group. The methyl group is composed of 1 carbon atom and 3 hydrogen atoms (CH_3). The ethyl group is composed of 2 carbon atoms and 5 hydrogen atoms (CH_2CH_3). In the ethyl group a CH_2 unit is "sandwiched" between the aromatic ring and a terminal CH_3, or methyl group. Toluene, ethylbenzene, and *ortho-*, *meta-*, and *para-*xylenes all are single-ring aromatic compounds where one or two hydrocarbon atoms have been replaced by one or two of these alkyl groups. As illustrated on Figure 2.2, toluene is simply a benzene ring in which one of the hydrogen atoms has been replaced with a methyl group. In ethylbenzene, the hydrogen atom is replaced by an ethyl group. In the xylene isomers, two hydrogen atoms are replaced by two methyl groups. The prefixes "*ortho-*," "*meta-*," and "*para-*" refer to the position of the methyl groups on the benzene ring.

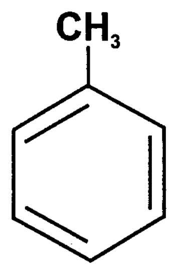
2.1.2.4 BTEX Composition

For this study, the weathering of the low-molecular-weight BTEX compounds is of particular concern because of their mobility within the environment and, in the case of benzene, its relatively high toxicity. To adequately characterize the degree or rate of BTEX weathering from mobile LNAPLs, the initial concentration of BTEX compounds within the original fuel is needed. Unfortunately, the exact concentration of BTEX compounds in a gasoline or jet fuel that is released to the environment typically is not known and can only be estimated based on compositional studies of fresh fuels. Cline *et al.* (1991) have noted that the specific composition of gasoline will vary depending on the source of the petroleum, the production method, the end use location, and the season of the year. Similarly, there is considerable variability in jet fuel composition based upon the distillate cuts of gasoline and kerosene from which the jet fuel is blended. Therefore, compositional studies of fresh fuels can provide only a range of BTEX concentrations within fresh fuels.

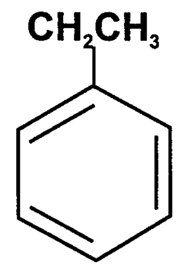
Figure 2.3 illustrates the ranges of benzene, toluene, ethylbenzene, total xylenes, and total BTEX concentrations in fresh JP-4, JP-5, and JP-8 jet fuels and fresh gasoline. As is evident from this figure, fresh gasoline has the highest mass fraction (in wt%) of BTEX compounds, followed by JP-4, JP-8, and JP-5 jet fuels.



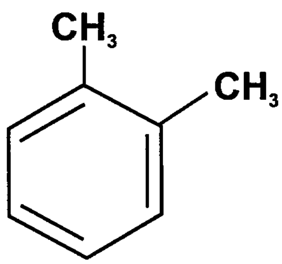
Benzene



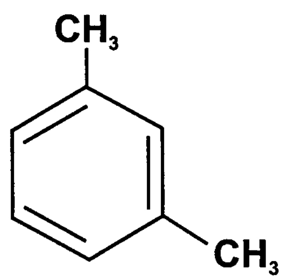
Toluene



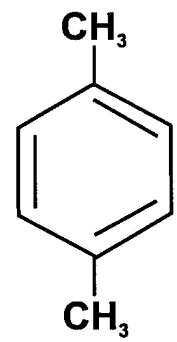
Ethylbenzene



***ortho*-Xylene**
(1,2-Dimethylbenzene)



***meta*-Xylene**
(1,3-Dimethylbenzene)



***para*-Xylene**
(1,4-Dimethylbenzene)

FIGURE 2.2

TYPICAL STRUCTURES OF BTEX COMPOUNDS

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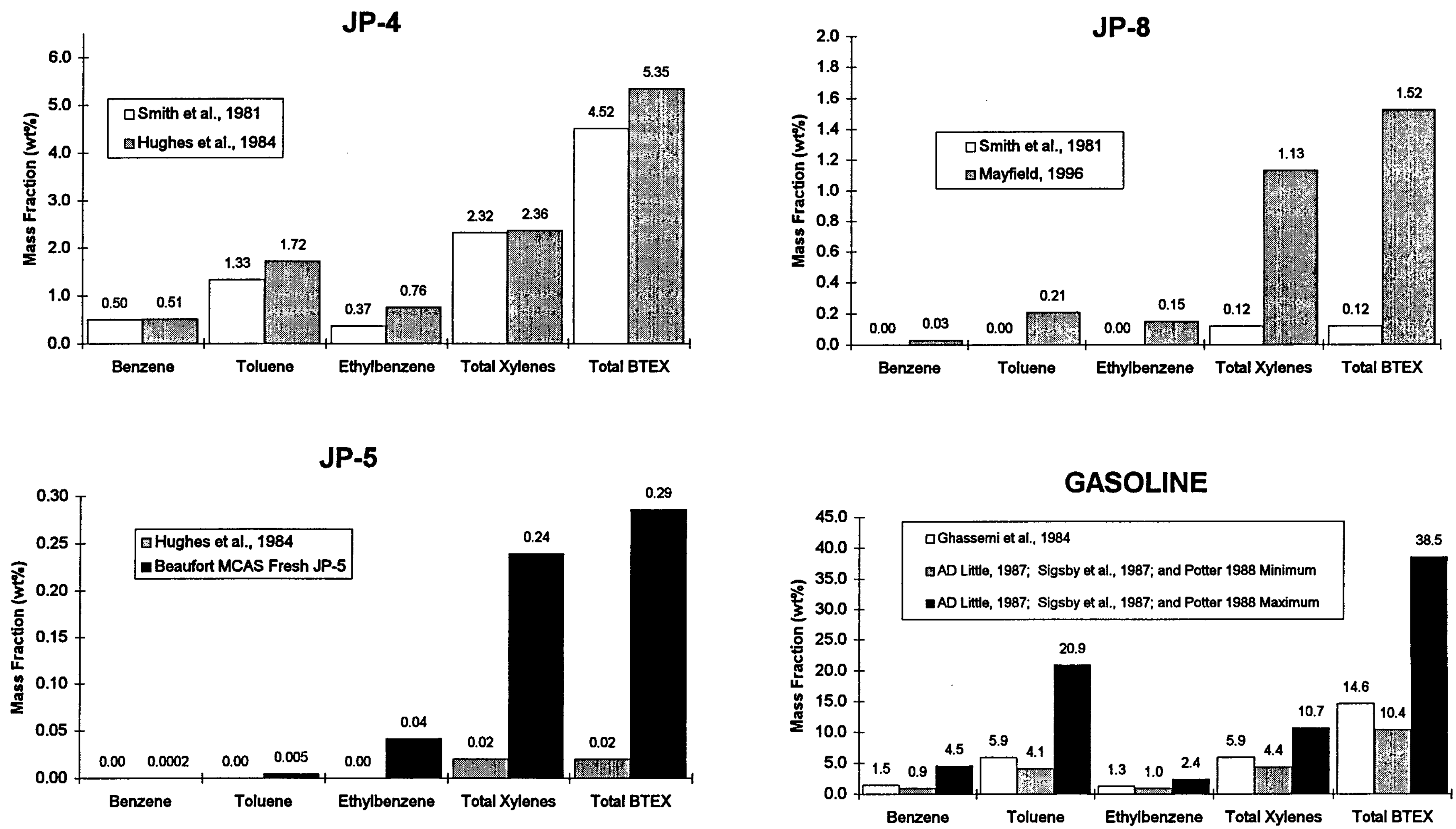
FIGURE 2.3
BTEX CONCENTRATIONS IN FRESH FUELS
FUEL WEATHERING STUDY



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2.1.2.4.1 Gasoline

For gasoline, there is a large disparity between the minimum and maximum BTEX mass fraction values presented by Potter (1988), Arthur D. Little (AD Little, 1987), and Sigsby *et al.* (1987) (Figure 2.3). Reported maximum concentrations for benzene and toluene are approximately five times the minimum concentrations. The total BTEX maximum concentration is nearly four times that of the reported minimum concentration (38.5 wt% versus 10.4 wt%). Similar disparities were evident in analytical results compiled by the Alberta Research Council (1993) for 124 gasoline samples. For benzene, the minimum and maximum reported concentrations were 0.34 wt% and 5.62 wt%, respectively, and the average benzene concentration was 1.86 wt%. For total BTEX, the minimum and maximum reported concentrations were 4.1 wt% and 45.4 wt%, respectively, and the average total BTEX concentration was 20.7 wt%. The BTEX mass fraction values for gasoline reported by Ghassemi *et al.* (1984) are somewhat lower than these average concentrations (Figure 2.3). Therefore, using the fresh-product values presented by Ghassemi *et al.* (1984) along with observed *in situ* BTEX concentrations to predict BTEX reductions in gasoline LNAPL would be more conservative than using average concentrations from the other studies cited above.

2.1.2.4.2 JP-4

Figure 2.3 presents JP-4 BTEX concentrations reported by Hughes *et al.* (1984) and Smith *et al.* (1981). In the Hughes *et al.* (1984) study, 54 JP-4 samples were analyzed by gas chromatography/flame ionization detection (GC/FID) analysis, and results were reported in milligrams per milliliter (mg/mL). Mass fraction (wt%) results shown in Figure 2.3 were obtained using a maximum density value of 802 mg/mL for JP-4 at 15 degrees Celsius (°C) (Martel, 1987). Mass fraction results presented by Smith *et al.* (1981) were obtained from JP-4 samples analyzed by gas chromatography/mass spectrometry (GC/MS). As shown on Figure 2.3, BTEX mass fraction results presented by Smith *et al.* (1981) are slightly lower than those presented by Hughes *et al.* (1984), and therefore represent more conservative initial values for estimating mass fraction BTEX reductions in JP-4 mobile LNAPL.

2.1.2.4.3 JP-8

BTEX mass fraction results for JP-8 as determined by Smith *et al.* (1981) and Mayfield (1996) also are presented in Figure 2.3. Mass fraction BTEX results presented by Smith *et al.* (1981) were obtained by GC/MS analysis. In the Mayfield (1996) study, 63 JP-8 samples were analyzed by GC/MS and results were presented in milligrams per liter (mg/L). Average mass fraction values shown on Figure 2.3 were obtained using a maximum density value of 840 mg/L for JP-8 at 15 °C (Martel, 1987). The disparity in BTEX concentrations between these two studies is significant. BTEX concentrations presented by Smith *et al* (1981) are approximately one-tenth the concentrations presented by Mayfield (1996). The reason for this disparity is not known, but may have resulted from changes in JP-8 manufacturing methods or specifications between 1980 and 1996. The Mayfield (1996) study represents a more contemporary and comprehensive review of JP-8 composition, and likely better represents JP-8 jet fuel used in the 1990s. Use of the lower JP-8 BTEX concentrations, as determined by Smith *et al.* (1981), for predicting mass fraction reductions in JP-8

LNAPL while extremely conservative, may not be tenable if BTEX concentrations in site LNAPL exceed these values.

2.1.2.4.4 JP-5

Limited BTEX compositional data were available for JP-5. Results shown on Figure 2.3 are from one fresh JP-5 sample analyzed by Hughes *et al.* (1984) and from one fresh JP-5 sample obtained from Beaufort Marine Corps Air Station (MCAS) in Beaufort, South Carolina and analyzed during this study (see Sections 3 and 4). Total BTEX concentrations in both samples were well below 1 wt%. While these data are limited, the relatively insignificant concentrations of BTEX in fresh JP-5 are likely to limit environmental threats from JP-5 releases, especially in comparison to gasoline and JP-4 releases.

2.2 SUBSURFACE LNAPL DISTRIBUTION AND RECOVERY

Characterization of fuel release sites where LNAPL is present in the subsurface is often difficult because of the complex transport parameters and mechanisms associated with LNAPL and separate-phase contamination. Subsurface migration and distribution of LNAPLs, as well as LNAPL persistence and strength as a source of soil and groundwater contamination, is governed by petroleum release factors, soil and aquifer properties, and LNAPL characteristics (Mercer and Cohen, 1990; Pfannkuch, 1984). The primary petroleum release factors influencing migration and distribution are the volume of the release, the release rate, and the area of the release. Influential subsurface properties include, but are not limited to, lithology, soil permeability, pore size distributions, porous media wettability, fluid pressure at and above the water table, and water table fluctuations. Characteristics of the LNAPL itself, such as density and viscosity, also influence subsurface distribution and migration (Newell *et al.*, 1995). Once LNAPL is released to the subsurface environment, a defined interface between the LNAPL and soil, air, and water, in the subsurface, typically does not exist (Newell, *et al.*, 1995).

2.2.1 LNAPLs in the Unsaturated Zone

In the unsaturated, or vadose, zone, movement of LNAPL initially is controlled by its fluid density and viscosity as it moves downward under the force of gravity (Hunt *et al.*, 1988). Subsurface heterogeneities may cause lateral spreading and trap lenses of LNAPL above layers of lesser permeability soils during downward migration. Interfacial forces (e.g., surface tension between soil-air and soil-water and the LNAPL) and soil capillary forces can cause residual masses of the LNAPL to become trapped in soil pores as ganglia and lenses (Hunt *et al.*, 1988; Powers *et al.*, 1991; Seagren *et al.*, 1993). Because this residual LNAPL can remain trapped in the unsaturated zone for an indefinite length of time, on the order of decades to centuries (Hunt *et al.*, 1988), it becomes a long-term source of groundwater contamination via infiltrating precipitation or a rising water table (Abriola and Pinder, 1985; Seagren *et al.*, 1993). If the volume of the fuel release is relatively small and the depth to groundwater is great, the entire LNAPL volume may be retained in soil pores as residual LNAPL and not reach the water table.

2.2.2 LNAPLs in the Saturated Zone

If the fuel release is of sufficient volume to reach the water table, the mobile LNAPL fraction will spread laterally and form a floating pool at the capillary fringe above the water table (Pfannkuch, 1984; Voudrias *et al.*, 1994;). With water table fluctuations caused by seasonal recharge and depression, or by local pumping, an LNAPL smear zone can form over the range of water table fluctuation (McKee *et al.*, 1972; Dietz, 1980; Schwille, 1984; Voudrias *et al.*, 1994;). Like the residual LNAPL in the unsaturated zone, the LNAPL smear zone can be highly variable, with residual LNAPL present as discrete ganglia to fully saturated mobile LNAPL lenses (Hunt *et al.*, 1988). Also, the immiscible nature of LNAPLs can cause discrete LNAPL "blobs" to become trapped in groundwater (Yang *et al.*, 1995) and to be only partially remobilized during rising water table conditions (Hunt *et al.*, 1988).

2.2.3 LNAPL Recovery

Mobile LNAPL, or free product, recovery at fuel release sites often is difficult, expensive, and only marginally effective (Farr *et al.*, 1996). Recovery of free-phase fuel has proven to be difficult because of the complex interaction of hydrogeologic and LNAPL characteristics that tend to retain the mobile LNAPL. Typically, less than 25 to 35 percent of the mobile LNAPL that has spread out on the water table is recoverable (Farr *et al.*, 1996), with significant retention occurring in the capillary fringe during product recovery efforts (Testa and Paczkowski, 1989). Residual LNAPL retained in the unsaturated zone and immobile LNAPL blobs associated with the capillary fringe or submerged below the water table are unrecoverable by conventional means (Testa and Paczkowski, 1989; AFCEE, 1998). Nevertheless, regulatory requirements specifying removal of free product to the "degree practicable" traditionally have been interpreted as LNAPL removal to no more than a sheen (Lundy, 1997). This regulatory expectation, combined with the limited effectiveness of conventional LNAPL recovery methods, have tended to drive up remediation costs as remediation durations are extended with little product recovery or risk reduction.

More recently a risk-based remediation approach to free product recovery has been proposed (Farr *et al.,* 1996; Lundy, 1997; AFCEE, 1998). Under this approach, site-specific environmental and health risks posed by the mobile LNAPL are evaluated in combination with the feasibility, effectiveness, and cost of free product recovery. At some sites it may be possible to demonstrate that the cost of free product recovery is not justified by a commensurate reduction in site risk. In these cases, it may be more appropriate to model the expected limit of plume migration and to expand the long-term monitoring well network to accommodate plume expansion rather than trying to limit expansion through source reduction (AFCEE, 1998).

2.3 LNAPL WEATHERING MECHANISMS

The term "weathering," or attenuation, refers to the combined effects of natural destructive and non-destructive processes to reduce the persistence, mobility, mass, and toxicity of the fuel contaminant in the environment. The majority of information currently available regarding subsurface fuel contamination examines the effects of specific natural attenuation mechanisms such as dissolution, biodegradation, and volatilization as they apply to soil and groundwater contamination. While the literature

has focused on these mechanisms as they apply to attenuation of chemicals sorbed to soil and dissolved in groundwater, mobile LNAPL weathering also is a function of these processes.

The primary mechanisms acting to reduce the strength of a LNAPL source are dissolution, volatilization, and biodegradation. These mechanisms are influenced by physical and chemical properties of the chemical compounds in the source product, as well as by physical, chemical, and biological properties of the soil and groundwater system. An illustration of these weathering mechanisms is shown on Figure 2.4.

2.3.1 Dissolution

Dissolution is the dissolving of chemical substances from a residual or mobile NAPL into percolating precipitation water and/or the groundwater. At gasoline and jet fuel release sites, dissolution or partitioning of the BTEX compounds from the LNAPL into groundwater represents the most significant source of groundwater contamination and likely the most significant mechanism of BTEX depletion in mobile LNAPLs (Huntley and Beckett, 1997). LNAPL dissolution is governed by the characteristics of the aquifer matrix (including effective porosity and groundwater velocity), physical properties of the LNAPL (e.g., surface area of the LNAPL in contact with groundwater), and characteristics of the specific LNAPL contaminant (e.g., effective water solubility) (Wiedemeier *et al.*, 1995).

2.3.1.1 Effective Water Solubility of BTEX

Solubility of a substance in water is defined as the mass of the substance that will dissolve in a unit volume of water (typically expressed in mg/L). According to Montgomery (1996), the water solubility of a compound is arguably the most important factor in determining the fate and transport of the compound in the subsurface. The aromatic compounds are among the most mobile of dissolved fuel contaminants at gasoline and jet fuel release sites because of their relatively high water solubilities. Single-ring BTEX compounds are significantly more water soluble than the two-ring naphthalenes, as shown in Table 2.1. Pure-phase water solubilities for the BTEX compounds range between 157 and 1,750 mg/L. Based on these values, benzene is the most water-soluble of the BTEX compounds, followed by toluene, ethylbenzene, and xylenes. In various soil column water-flushing experiments (Borden and Kao 1992; Rixey *et al.*, 1992; Voudrias *et al.*, 1994), benzene, toluene, ethylbenzene and xylene were flushed from soil columns in order of decreasing solubility. With increased compound solubility, there is increased dissolution flux, indicating compound depletion or weathering in a fuel LNAPL will be more rapid for the more water-soluble compounds like benzene.

The dissolution flux of compounds in fuel LNAPLs also is influenced by the compound's concentration in the LNAPL. In fresh JP-4 jet fuel, benzene comprises approximately 0.50 wt% of the fuel, and in gasoline, benzene typically constitutes no more than 4.5 wt% of the fuel (Figure 2.3). Similarly, toluene, ethylbenzene, and xylenes typically are present in gasoline and jet fuels at concentrations significantly less than 10 wt%. Therefore, the dissolution flux of these compounds is significantly less than if they were present in pure phase. As shown in Table 2.1, the actual concentrations of aromatic compounds in water resulting from fuel/water contact, are 1

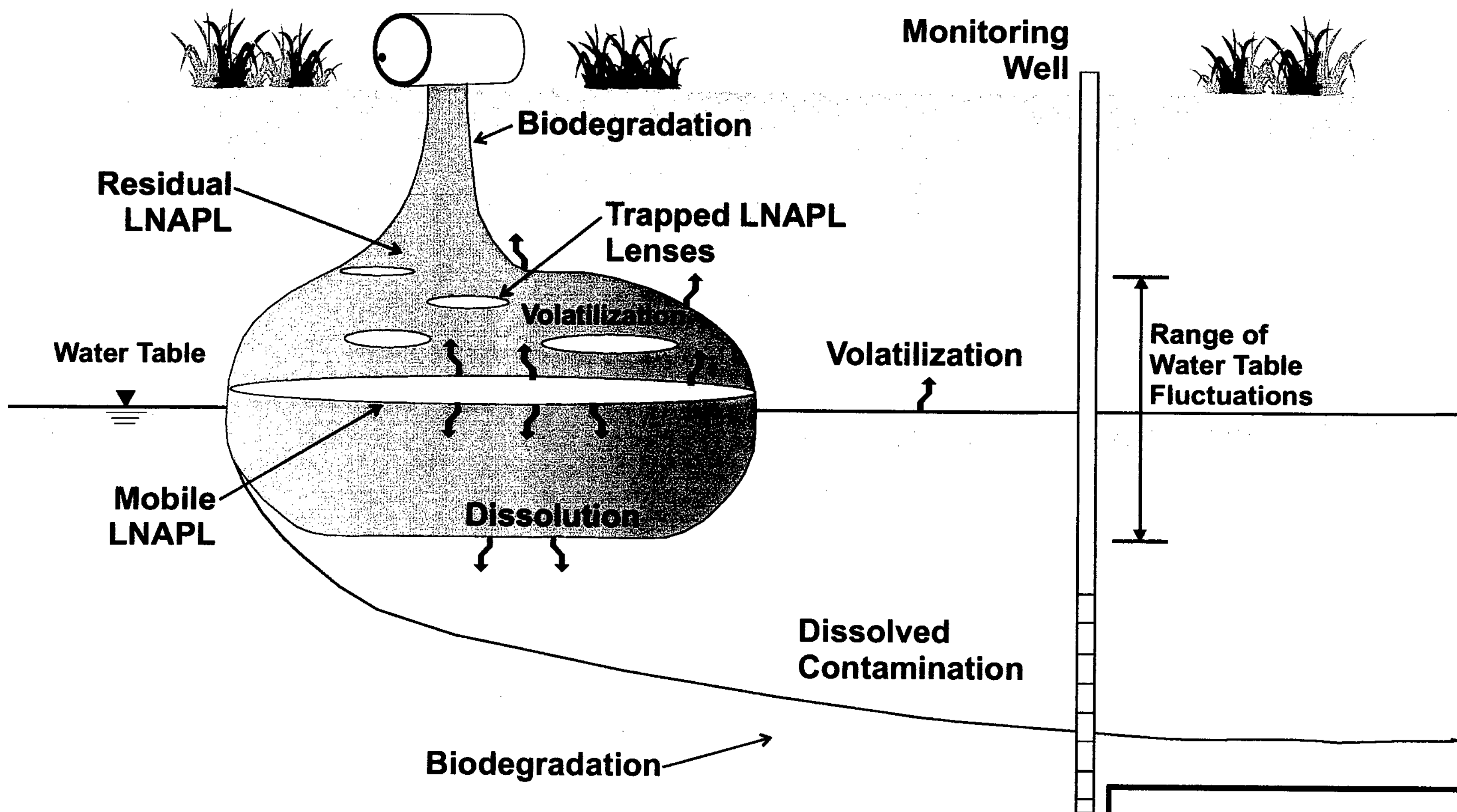

FIGURE 2.4

MECHANISMS OF LNAPL WEATHERING

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TABLE 2.1
DISSOLVED CONCENTRATIONS OF AROMATIC FUEL HYDROCARBONS
FUEL WEATHERING STUDY

Compound	Pure-Phase Water Solubility[a/] (mg/L)[b/]	Concentrations in Water in Contact with Fuel[c/] ("effective solubilities")		MCL[f/] (mg/L)
		JP-4[d/] (mg/L)	Gasoline[e/] (mg/L)	
Benzene	1,750	9.82	58.7	0.005
Toluene	524	8.49	33.4	1.0
Ethylbenzene	187	0.67	4.3	0.7
o-Xylene	167	1.21	6.9	NA[g/]
m-Xylene	157	2.01	11.0	NA
p-Xylene	180	0.41	4.4	NA
Xylenes	168	3.63	22.3	10
Trimethylbenzenes	97.7[h/]	0.87	1.1[i/]	NA
Naphthalene	22	0.39	---[j/]	0.02[k/]
Methylnaphthalenes	25.4[l/]	0.24	---	NA

[a/] Solubilities at 25°C (Montgomery, 1996).

[b/] mg/L = milligrams per liter.

[c/] Fuel to water ratio 1:10.

[d/] Smith et al., 1981.

[e/] American Petroleum Institute (1985).

[f/] MCL = maximum contaminant level (USEPA, 1996).

[g/] NA = not applicable.

[h/] Solubility for 1,3,5-trimethylbenzene.

[i/] Value for 1,2,4-trimethylbenzene.

[j/] --- = not available.

[k/] Health advisory value for 70-kilogram adult, lifetime exposure.

[l/] Value for 2-methylnaphthalene.

to 2 orders of magnitude less than their respective pure-phase water solubilities. The BTEX compounds are more soluble in fuel than in water, and tend to remain in the fuel.

This decrease in dissolution flux resulting from an equilibrium relationship between the aqueous phase and the multicomponent LNAPL has been described by Raoult's Law. Raoult's Law is based on a thermodynamic theory of multicomponent solutions and is typically valid for compounds that are present in relatively low concentrations within the solution (M&E, 1993). Using Raoult's Law, the effective water solubility of a compound (C_i) can be predicted by the product of the water solubility of the pure compound (S_i) and the mole fraction of the compound in the LNAPL (X_i):

$$C_i = X_i S_i \qquad \text{eq. 2.1}$$

In order to use Raoult's Law to estimate effective solubilities, the mole fraction or molecular percent of a compound in an LNAPL or a fresh fuel must be known. However, analytical results for fuel and LNAPL components are typically reported in wt% or vol%, not molecular percent. Using this equation, and estimates of molecular percent for BTEX in gasoline, semiquantitative estimates of effective water solubility have been determined for gasoline (M&E, 1993). However, a 20 to 30 percent disparity was apparent between predicted values and measured water concentrations resulting from gasoline contact (Table 2.1). This disparity is thought to have resulted from inherent uncertainties with the predictions of mole fraction in multicomponent fuels (M&E, 1993).

Despite the difficulty with using Raoult's Law directly, it is useful in illustrating the relationship between compound concentration and compound solubility in evaluating effective solubility at fuel-contaminated sites. As shown in Table 2.1, the pure-phase water solubility of toluene is less than one-third the pure-phase water solubility of benzene, yet the effective solubility of toluene when water is in contact with JP-4 or gasoline is much closer to the effective water solubility of benzene. This results from the higher concentration or mole fraction of toluene in the fuel compared to that of benzene (Figure 2.3). Based on this relationship and the effective solubility values presented in Table 2.1, it appears that ethylbenzene and xylenes are not sufficiently present in JP-4, or sufficiently soluble in water, to consistently exceed regulatory maximum contaminant levels (MCLs) at JP-4 contaminated sites. At sites contaminated by lower-BTEX-content fuels (i.e., JP-5 or JP-8), there is even less dissolution flux of BTEX compounds into site groundwater.

2.3.1.2 Fuel/Water Partitioning Coefficients

Fuel/water partitioning coefficients offer another method for evaluating fuel contaminant dissolution from fuel LNAPLs into water. The fuel/water partitioning coefficient (K_{fw}) is a dimensionless constant defined as the ratio of a compound in the fuel (C_f) to the compound's equilibrium concentration in water in contact with the fuel (C_w):

$$K_{fw} = C_f / C_w \qquad \text{eq. 2.2}$$

Fuel/water partitioning coefficients demonstrate the relationship between water solubility of a compound and abundance of the compound in a fuel. Table 2.2 provides K_{fw} values for constituents of JP-4 and gasoline. As shown, K_{fw} values for BTEX compounds in JP-4 are significantly higher than gasoline values. Relative to gasoline, a larger portion of the BTEX compounds have a tendency to stay in JP-4, resulting in lower equilibrium concentrations in water and higher K_{fw} values.

2.3.1.3 Equilibrium versus Nonequilibrium

Significant debate appears in the literature regarding the applicability of equilibrium conditions when assessing dissolution (Hayden *et al.*, 1992; Seagren *et al.*, 1993; Voudrias *et al.*, 1994; and Yang *et al.*, 1995). Use of Raoult's Law and K_{fw} values to assess contaminant dissolution assumes that equilibrium conditions exist. Often equilibrium is assumed in order to simplify dissolution calculations in subsurface flow models (Seagren *et al.*, 1993). For example, once the concentration of a contaminant is known in one phase, equilibrium partitioning is used to calculate the concentration in the other phase at the same location. However, serious errors in prediction of contaminant reduction have occurred when equilibrium assumptions are used in groundwater modeling (Powers *et al.,* 1991). As noted by Bruce *et al.* (1991), dissolved concentrations of the BTEX compounds rarely exceed 20 percent of the calculated equilibrium concentration, unless LNAPL is present as a sheen or colloids. One hypothesis suggests that the lack of equilibrium concentrations occurs from less thorough mixing of the fuel (LNAPL) and water in the field as compared to the laboratory (Bruce, 1993). Groundwater sampling often is performed over several feet of saturated soil, and only the upper few inches of the soil column is in contact with LNAPL. Significant dilution of dissolved hydrocarbons will result in concentrations far less than theoretical equilibrium values.

As discussed by Seagren *et al.* (1993), if equilibrium conditions exist in the field, the dissolution rate becomes a function of advection (groundwater transport of the contaminant away from the source area) and/or biodegradation. Under this scenario, the dissolution rate is enhanced by contaminant removal from the interphase (LNAPL and aqueous) boundary, thereby increasing the dissolution flux. However, if nonequilibrium conditions exist (e.g., the groundwater concentration of benzene is significantly less than its effective solubility [Table 2.1]), the dissolution rate cannot be enhanced by advection or biodegradation that further reduces the aqueous concentration.

The equilibrium assumption as it applies to LNAPLs and groundwater contaminant concentrations has yet to be adequately demonstrated (Powers *et al.*, 1991). Also, while generalizations can be made, no quantitative criteria exist for determining when equilibrium or nonequilibrium conditions exist (Seagren *et al.*, 1993). Because it has been argued that the rate of dissolution is a significant limiting factor in remediation of residual LNAPLs (Yang *et al.,* 1995), it can also be presumed that dissolution is rate-limiting (i.e., a predominant mechanism) for mobile LNAPL weathering.

2.3.2 Volatilization

Volatilization, or evaporation, is the loss of a compound from a liquid or solid state to a vapor state. For surface spills, important factors affecting volatilization include

TABLE 2.2
FUEL/WATER PARTITIONING COEFFICIENTS FOR BTEX AND TMBs
FUEL WEATHERING STUDY

Compound	Fuel/Water Partitioning Coefficient (K_{fw})		
	JP-4 Jet Fuel[a/]	Gasoline[b/]	Gasoline[c/]
Benzene	2,455	231	350
Toluene	2,754	895	1,250
Ethylbenzene	4,786	3,411	4,500
o-Xylene	7,079	3,162	3,630
m-Xylene	3,715	3,539	4,350
p-Xylene	7,586	2,961	4,350
1,2,3-Trimethylbenzene	NA[d/]	NA	13,800
1,2,4-Trimethylbenzene	8,913	12,270	NA
1,3,5-Trimethylbenzene	NA	6,493	NA

Source: Wiedemeier, 1995.

[a/] Smith et al., 1981.

[b/] Bruce et al., 1991.

[c/] Cline et al., 1991.

[d/] NA = not analyzed.

temperature, vapor pressure of the constituents, and wind speed. For subsurface releases, temperature and vapor pressure are important, but volatilization requires diffusion through a porous medium; therefore, soil moisture and soil porosity also are important (LaGrega *et al.*, 1994). Subsurface rates of volatilization are directly proportional to soil porosity, pore size distribution, and temperature, but inversely proportional to volumetric moisture content (Hillel, 1980).

Relative volatility of compounds at equilibrium conditions can be compared by an air/water partitioning coefficient known as Henry's Law Constant (H). Henry's Law states that under equilibrium conditions, the partial pressure of a gas (i.e., volatile chemical) (P_g) above a liquid is proportional to the concentration of the chemical in the liquid (C_L):

$$P_g = HC_L \qquad \text{eq. 2.3}$$

Henry's Law Constant values for BTEX, trimethylbenzenes (TMBs), and naphthalenes are listed in Table 2.3. As a general rule of thumb, compounds with Henry's Law Constants greater than 10^{-3} are considered very volatile (M&E, 1993). As shown in Table 2.3, the BTEX compounds and TMBs are more volatile than naphthalene and 2-methylnaphthalene. Generally speaking, compound volatility decreases with increasing carbon atoms. On a unit-carbon basis, the alkanes are more volatile than the aromatics (Nakles *et al.*, 1996).

As with dissolution, contaminant volatilization from a LNAPL is influenced by the concentration of the contaminant in the LNAPL. In other words a Raoult's Law expression similar to that discussed in Section 2.3.1.1 can be applied.

Enhanced volatilization using soil vapor extraction (SVE) techniques is commonly used for vadose zone cleanup at fuel-contaminated sites; however, no field studies were identified that evaluated "equilibrium" volatilization at sites having subsurface free-phase product. Volatilization is expected to be a significant weathering mechanism for petroleum products such as gasoline, JP-4, and JP-8. From a study on the fate of JP-8 in quiescent flask systems containing water and water/sediment mixtures, evaporation or volatilization from water was the major removal mechanism for low-molecular-weight, volatile hydrocarbons (Dean-Ross *et al.*, 1992). In the same study it was determined that the presence of sediment can sequester jet fuel and render it less susceptible to volatilization. Intuitively, greater contact between soil gas and residual LNAPL would result in greater mass loss rates due to volatilization than would be expected in soils saturated with mobile LNAPL.

2.3.3 Biodegradation

2.3.3.1 Residual LNAPL and Groundwater

Most of the literature pertaining to *in situ* biodegradation refers to residual LNAPL contaminants in soil and contaminants dissolved in groundwater. As mentioned in Section 2.3.1.3, dissolution appears to be a rate-limiting factor in weathering, especially as it relates to biodegradation. If equibrium conditions exist, biodegradation of dissolved petroleum contaminants will reduce aqueous contaminant concentrations, thereby enhancing dissolution rates by increasing mass transfer of soluble compounds

TABLE 2.3
HENRY'S LAW CONSTANTS FOR BTEX, TMBs, AND NAPHTHALENES
FUEL WEATHERING STUDY

Compound	Henry's Law Constant (atm-m^3/mol)
Benzene	5.28E-03
Toluene	6.42E-03
Ethylbenzene	7.88E-03
o-Xylene	4.87E-03
m-Xylene	7.44E-03
p-Xylene	7.44E-03
1,2,3-Trimethylbenzene	3.18E-03
1,2,4-Trimethylbenzene	5.70E-03
1,3,5-Trimethylbenzene	6.73E-03
Naphthalene	7.34E-04
2-Methylnaphthalene	3.18E-04

Source: Montgomery, 1996.
Henry's Law Constant values at 25°C.

from residual LNAPLs into groundwater (Seagren *et al.*, 1993; Yang *et al.*, 1995). As a result of this diffusion limitation, mass loss rates of dissolved contaminants from biodegradation appear initially to be between zero and first-order (Song *et al.*, 1990), and to decrease with time (Barker *et al.*, 1987).

The kinetics of biodegradation are complicated by the fact that biodegradation is compound-specific and is significantly affected by the geochemistry of the subsurface environment. Dean-Ross (1993) examined the fate of JP-4 jet fuel in subsurface soils and discovered that for the less volatile, higher-molecular-weight jet fuel components, biodegradation represented a significant mechanism for reducing soil contamination. Song *et al.* (1990) concluded that saturated compounds such as hexane generally are more easily biodegraded than the corresponding aromatic compounds. In a study by Barker *et al.* (1987), mass loss rates for aromatics in groundwater due to biodegradation were greatest for xylenes, followed by toluene, and benzene. Other factors playing an important role in contaminant biodegradation include availability of nutrients, availability of oxygen and other electron acceptors, and the interfacial area available for mass transfer to aqueous or gaseous phases (Yang *et al.*, 1995). For residual LNAPLs, the size of the LNAPL globules impacts biodegradation rates, with smaller globules resulting in greater interfacial area for mass transfer, and faster biodegradation rates (Yang *et al.*, 1995).

2.3.3.2 Mobile LNAPLs

No studies were identified that addressed intrinsic biodegradation of LNAPL pools. In addition, practical bioremediation of free-phase product has not been demonstrated (Newell *et al.*, 1995), most likely as a result of the following:

- Mobile LNAPLs represent a hostile environment for the survival of most soil microbes; and

- Requirements for microbial proliferation (e.g., nutrients, terminal electron acceptors, pH, moisture, osmotic potential) are difficult and may be impossible to deliver or maintain in the LNAPL pool (Huling and Weaver, 1991).

Consequently, effective bioremediation and tangible intrinsic biodegradation is likely to be limited to the periphery of the mobile LNAPL zone (i.e., residual LNAPL and aqueous phases).

2.4 OTHER FACTORS INFLUENCING LNAPL WEATHERING

In addition to the LNAPL weathering mechanisms discussed above, hydrocarbon layer thickness, groundwater velocity, soil/aquifer material, and distance from the source area are factors expected to impact BTEX depletion within mobile and residual LNAPLs.

2.4.1 Hydrocarbon Layer Thickness

The hydrocarbon layer thickness at the interface of the unsaturated and saturated zones is presumed to influence BTEX dissolution from the LNAPL (Huntley and Beckett, 1997). Dissolution modeling of a 10-centimeter thick LNAPL pool in fine

sand indicated that the effective solubility of benzene could be reduced to approximately 0.001 mg/L in less than a year. However, modeling results for a 50-centimeter thick pool indicated it would take approximately 70 years to reach the same effective solubility (Huntley and Beckett, 1997). The larger the LNAPL pool thickness, the more slowly benzene is removed from the LNAPL pool.

It is important to note that LNAPL thickness measurements from groundwater monitoring wells are not indicative of LNAPL thicknesses in the formation (Blake and Hall, 1984; Hall *et al.*, 1984; Hughes *et al.*, 1988; Testa and Paczkowski, 1989; Farr *et al.*, 1990; Mercer and Cohen, 1990; Huntley *et al.*, 1994). Mercer and Cohen (1990) suggest that the measured LNAPL thickness in wells is typically 2 to 10 times greater than the LNAPL thickness in the formation. In addition, depiction of mobile LNAPL as a distinct layer present above the water capillary fringe has been challenged (Farr *et al.*, 1990; Lenhard and Parker, 1990). It has been suggested that hydrocarbon-saturated soil layers do not exist at sites with measurable LNAPL; rather, LNAPL and water coexist in soil pores at residual LNAPL saturations ranging up to 40 to 50 percent (Huntley *et al.*, 1994). Nevertheless, the thickness of LNAPL within a soil column is expected to influence LNAPL weathering rates.

2.4.2 Groundwater Velocity

If equilibrium conditions exist between the LNAPL and the aqueous phase (Section 2.3.1.3), contaminant dissolution and depletion from the LNAPL source is enhanced with advection or groundwater flow. In soil column experiments performed by Miller *et al.* (1990), the rate of mass transfer between a toluene NAPL and the aqueous phase was found to be directly related to the aqueous-phase velocity. In addition, equilibrium conditions between the two fluid phases were rapidly achieved over a wide range of test conditions. Considering these findings, it is assumed that sites with higher groundwater velocities may exhibit more rapid BTEX depletion of mobile LNAPLs in contact with the water table.

2.4.3 Soil/Aquifer Material

The type of soil/aquifer material at a fuel release site is expected to influence LNAPL weathering primarily as a result of fluid distribution and migration. Wettability, or the tendency for one fluid to spread on or preferentially coat a solid surface in the presence of another fluid with which it is immiscible, is impacted by the presence of organic matter, mineralogy, and saturation history of the porous medium (Mercer and Cohen, 1990). Capillary pressure also impacts the configuration and magnitude of trapped residual LNAPL and is a function of soil pore size (Newell *et al.*, 1995). LNAPLs have been observed to preferentially migrate through sands and gravels, rather than silts and clays (Newell *et al.*, 1995).

2.4.4 Distance from Source Area

It is presumed that LNAPL weathering is impacted by the distance from the original fuel release location. Because of the effects of sequestration, increased surface area, and decreased contaminant mass, it is presumed that periphery LNAPL weathers at a faster rate than core area LNAPL. It is unlikely that LNAPL weathering occurs at a uniform rate across the area of impact (Landon and Hult, 1991).

2.5 PETROLEUM HYDROCARBON WEATHERING STUDIES

No weathering studies were identified that evaluated BTEX depletion from gasoline and/or jet fuel LNAPLs with the intent of refining contaminant source term reductions for fate and transport modeling. Based on a review of the literature, hydrocarbon weathering studies have primarily focused on weathering of crude oil and heavier refined petroleum products such as fuel oils and diesel fuel (Zurcher and Thuer, 1978; Fried, 1979; Law, 1980; Gundlach *et al.,* 1983; Baedecker *et al.*, 1987; Eganhouse *et al.,* 1988; Baedecker and Cozzarelli, 1991; Landon and Hult, 1991; Baedecker *et al.*, 1993; Christensen and Larsen, 1993; Douglas *et al.*, 1994; Vandermeulen *et al.,* 1994; Douglas *et al.*, 1996; Nakles *et al.*, 1996). Typically, these investigations have focused on the high-molecular-weight, low-solubility fractions in assessing changes in chemical composition. Many of these studies have utilized hydrocarbon ratios and internal biomarkers to evaluate relative degrees of weathering, to estimate spill age, and for source identification (Christensen and Larsen, 1993; Douglas *et al.,* 1994; Douglas *et al.*, 1996; Kaplan *et al.*, 1996.). A brief summary of the more pertinent findings from the literature search is presented below.

2.5.1 Bemidji Oil Release Site

In 1979, a crude oil pipeline near Bemidji, Minnesota ruptured and released approximately 450,000 gallons of crude oil into a glacial outwash aquifer. In 1982, the site was selected for a long-term interdisciplinary study by the US Geological Survey. A study performed by Landon and Hult (1991) represents the investigation identified during the literature search that had objectives most similar to those of this fuel weathering study.

The purpose of the Landon and Hult study was to evaluate oil loss rates at a spill site in order to refine contaminant source-term reduction estimates for fate and transport models. Oil samples were collected from various locations within mobile LNAPL pools over a 10-year period to establish oil loss rates. Rather than chemical composition, changes in oil specific gravity and kinematic viscosity were used to calculate oil mass loss rates. Based on sample results, annual oil-mass loss ranged from 0.1 to 1.25 percent, and total cumulative oil losses after approximately 10 years of weathering were reported to be as much as 11 percent. Important conclusions from this investigation included:

- Oil-mass loss rates were found to vary spatially (i.e., to depend upon location within the oil pool);
- Oil-mass loss rates were found to vary temporally (i.e., to change based on relative age of the release);
- Volatilization of low-molecular-weight compounds was suspected to be the primary weathering mechanism.

Weathering rates for individual chemicals were not determined as part of the Landon and Hult (1991) study. However, depletion rates for BTEX compounds in refined petroleum products such as JP-4 and gasoline are expected to be greater than the total oil mass loss rates observed in mobile LNAPL at the Bemidji site.

2.5.2 Internal Biomarkers and Hydrocarbon Ratios

At oil release sites, the extent of oil or analyte depletion within soils or sediment has been estimated utilizing an internal biomarker or standard. For crude oil, the saturated pentacyclic (5-ring) triterpane known as hopane has been used because of its resistance to degradation (Douglas *et al.*, 1994; Douglas *et al.*, 1996). As biodegradation proceeds, the relative concentration of hopane remaining in the oil increases because of the removal of other more easily degraded compounds. As proposed by Douglas *et al.* (1994), the percent of oil depletion can be estimated by comparing the concentration of hopane in the weathered oil (H_1) with the concentration in the initial source oil (H_0) using the following equation:

$$\%\text{ oil depletion} = [1 - (H_0 / H_1)] \times 100 \qquad \text{eq. 2.4}$$

In addition, the amount of depletion of any one analyte within the oil can be determined using these hopane values in combination with analyte concentration in the degraded oil (C_1) and the analyte concentration in the source oil (C_0) as shown:

$$\%\text{ analyte depletion} = [1 - ((C_1 / C_0)(H_0 / H_1))] \times 100 \qquad \text{eq. 2.5}$$

The use of these equations to determine total oil and analyte depletion is considered to be conservative (i.e., to provide minimum depletion estimates) because the hopane degrades very slowly (Douglas *et al.*, 1996). Equation 2.5 was used to determine analyte depletion in shoreline sediment samples following the Exxon™ Valdez oil spill. Analyte depletion in these samples ranged from 30 to 70 percent 16 months after the spill (Douglas *et al.*, 1996). It also was noted during this study that the relative degree of PAH depletion decreased with increasing ring numbers and increased alkylation.

Similarly, hydrocarbon ratios have been used to determine the degree of change in oil/fuel composition with time and weathering. A ratio that is frequently used to assess biodegradation is the n-C_{17}/pristane ratio. The n-C_{17} compound is simply a saturated 17-carbon alkane. Pristane is a 19-carbon isoalkane, or isoprenoid, that is more resistant to biodegradation than the alkane n-C_{17}. In a study performed by Christensen and Larsen (1993) on biodegradation of residual diesel fuel in soils, the n-C_{17}/pristane ratio had the highest correlation factor with fuel residence time in soils of any similar n-alkane/isoalkane ratio. Based on the results of this study, Christensen and Larsen (1993) determined that the n-C_{17}/pristane ratio could be used to determine the age of a diesel oil spill within a range of plus or minus 2 years at a 95-percent level of confidence. The data also suggested that the n-alkanes biodegrade at a zero-order rate within residually contaminated soils.

2.5.3 BTEX Ratios

For refined petroleum products with higher initial BTEX concentrations (e.g., gasoline), ratios of the BTEX compounds have been used to estimate the relative state of degradation. As noted by Kaplan *et al.* (1996), BTEX results offer an excellent means of evaluating fuel alteration resulting from dissolution and volatilization. Comparing concentration ratios of the BTEX compounds in groundwater samples will typically show that benzene and toluene will be enriched relative to ethylbenzene and

xylenes. However, in soil samples ethylbenzene and xylenes are preferentially retained relative to benzene and toluene.

Kaplan *et al.* (1996) suggest that a useful parametric ratio to evaluate gasoline partitioning is (benzene+toluene)/(ethylbenzene+xylenes). Based on their results, the average (B+T)/(E+X) ratio ranged from 0.74 to 0.88 for newly dispensed gasolines; whereas, the average ratio for free product, water, and soil were 0.65, 0.97, and 0.48, respectively. In laboratory studies by Kaplan *et al.* (1996), (B+T)/(E+X) ratios of 1.0 to 5.0 have been found for water in contact with fresh gasoline. At fuel release sites where groundwater samples are collected in the source area and the (B+T)/(E+X) ratio falls within this range, a recent release is indicated. At sites where the gasoline release is more than 10 years old, the ratio in the vicinity of the source area typically is less than 0.5. Ratios greater than 5.0 typically are encountered at sites where the groundwater samples are collected at a distance from the source area, and benzene and toluene concentrations are relatively higher than ethylbenzene and xylenes concentrations because of dissolution effects.

SECTION 3

SELECTION OF STUDY SITES

The primary objective of this study was to determine a range of natural *in situ* weathering rates for mobile LNAPL associated with jet fuels and gasoline releases based on the existing literature and data collected from sites with mobile LNAPL contamination. Because no case studies identified in the literature evaluated quantitative source strength reduction of the BTEX constituents within mobile LNAPL, field sampling of representative sites was determined to be necessary. The site selection criteria for the fuel weathering study are presented in Section 3.1. Sites included within the study are summarized in Section 3.2.

3.1 SITE SELECTION CRITERIA

To evaluate a site's potential as a candidate for the fuel weathering study, the following selection criteria were considered:

1. Presence of recoverable mobile LNAPL in the subsurface environment as a result of a jet fuel or gasoline release;
2. Known date of fuel release;
3. Single release confined to a relatively short period of time;
4. Minimal remediation of the site and mobile LNAPL;
5. Historic LNAPL analytical results, including BTEX;
6. Depth to groundwater less than 40 feet below ground surface (bgs); and
7. Department of Defense (DOD) sites.

Identifying sites that met all of the above-listed criteria proved to be a difficult task. Consequently, the criteria served as guidelines for site selection rather than rigid selection parameters. Each of the criteria and their consideration in site selection are briefly discussed below.

JP-4 and gasoline fuel release sites were preferred for the study because of the relatively high mass fraction of BTEX present in these source fuels (Figure 2.3). Source reduction (i.e., BTEX depletion) estimates using mobile LNAPL sampling data from these types of fuel release sites were anticipated to be more accurate because of the higher initial BTEX concentrations. However, due to the difficulty of finding an adequate number of sites meeting the selection criteria, JP-5 and JP-8 release sites also were included in the study. While benzene, toluene, and ethylbenzene concentrations are less than 0.40 wt% in JP-8 (Mayfield, 1996), and less than 0.05 wt% in JP-5 (based

on the fresh sample collected at Beaufort MCAS), it was hoped that concentrations of total xylenes, naphthalene, and methylnaphthalenes could be used to evaluate mobile LNAPL weathering rates for JP-5 and JP-8.

Recoverable mobile LNAPL was loosely defined during initial site screening as sufficient free product in a site monitoring well to allow collection of relatively undiluted product samples. One inch of mobile LNAPL was considered to be the minimum required thickness for site consideration.

Locating sites with a known date of fuel release (criterion 2) where the release was a one-time event confined to a relatively short period of time (criterion 3) was difficult, especially when combined with the requirement for recoverable mobile LNAPL (criterion 1). For many petroleum release sites, the specific date(s) of release is not documented and at best can be approximated based on known historical site activities. In addition, one-time releases of sufficient volume to produce a long-term mobile LNAPL in the subsurface environment are rare. Moreover, when such releases occur, they frequently trigger emergency response actions that compromise satisfaction of the fourth selection criterion (minimal site remediation).

Sites where limited or no site remediation had occurred were preferred for assessing *in situ* LNAPL weathering rates. Soil venting activities, such as SVE, bioventing, and bioslurping will increase volatilization and biodegradation of the BTEX fraction in LNAPL; therefore, a BTEX weathering evaluation of the mobile LNAPL remaining at such sites would be biased. Sites where limited product recovery or soil excavation has occurred were not excluded from consideration.

Historical mobile LNAPL BTEX sampling results were considered in lieu of a known spill or release date. The availability of BTEX concentrations from a previous sampling event could help define BTEX depletion curves for the mobile LNAPL. Historical LNAPL BTEX results at least 3 years old were desired, but such data were seldom available.

Sites with shallow groundwater (less than 40 feet bgs) were selected so that Geoprobe® sampling could be performed. This requirement precluded the selection of sites in arid regions with thick vadose zones and deep water tables. As a result, many of the sites selected for the study are located in coastal regions with shallower water tables.

Project funding and liability issues restricted the study to DOD sites. Because of this restriction, the selection pool of gasoline release sites was limited. While gasoline is used and stored at DOD facilities, most of the petroleum infrastructure is dedicated to storage and transfer of the various jet fuels, including JP-4, JP-5, and more recently, JP-8.

3.2 FUEL WEATHERING STUDY SITES

Eight primary sites were selected for the study. Summary information for the primary sites was submitted to AFCEE prior to field sampling activities (Appendix A). In addition, samples from four secondary sites were collected and analyzed to support

the study. Summary site data for the primary and secondary sites are provided in Table 3.1.

3.2.1 Site Summary

Based on the site-selection criteria summarized in Section 3.1, sample data from one gasoline, six JP-4, three JP-5, and two JP-8 fuel release sites were collected to evaluate mobile LNAPL weathering. Table 3.1 provides summary information for each site, including fuel type, volume and date of fuel release, and hydrogeologic information (e.g., soil type, approximate depth of water table, groundwater velocity, and free product or mobile LNAPL thickness). Figure 3.1 illustrates the geographic distribution of the selected sites. The fuel weathering study work plan and site-specific addenda (Appendix A) provide additional information on the primary sites selected for the study. Further information on sample collection methods are presented in Section 4.

TABLE 3.1
SITE SUMMARY
FUEL WEATHERING STUDY

Site/Location	Fuel Type	Date of Release	Amount Released (gallons)	Soil Type[a]	Depth to Water Table (feet bgs[b])	Groundwater Velocity (feet/year)	Free Product Thickness (feet) and Date	References
Primary Sites								
Tank 349 Offutt AFB, NE	Gasoline	1990	Unknown	Clay/Sand	39-42	11	2.23(6/96)	Parsons ES, 1997
Bldg 1610 Shaw AFB, SC	JP-4	June 1994	Unknown	Sand	29-33	400	2.5(8/96)	Parsons ES, 1998
Pipeline Leak Site Myrtle Beach AFB, SC	JP-4	January 1981	123,000	Clay/Sand	2-8.5[c]	420	3.79(11/95)	ECT, 1996
Tank 1 Area, DFSP-Charleston, Hanahan, SC	JP-4	October 1975	83,000	Clay/Sand	18-22	62	1.77(5/96)	USGS, 1997
Spill Site No. 2 Eaker AFB, AR	JP-4	October 1973	Unknown	Sandy Silt	8-14	16	1.18(8/97)	Halliburton NUS, 1996
Tank Farm C Beaufort MCAS, SC	JP-5	June 1990	10,600	Silty Sand	2-8	20	0.13(5/96)	USGS, 1996
Day Tank 1, Facility 293 Cecil Field NAS, FL	JP-5	1981	497,000	Silty Sand	5-8	6	0.78(8/96)	ABB, 1995a; 1996
Bldg 4522 Seymour Johnson AFB, NC	JP-8	December 1995	5,000	Sand	4-9	130	2.8(4/96)	Parsons ES, 1996c
Secondary Sites								
KC-135 Crash Site Wurtsmith AFB, MI	JP-4	October 1988	3,000	Sand	9-12	110	0.22(3/91)	Parsons ES, 1996a
Washrack/Treatment Area McChord AFB, WA	JP-4	1975	100,000	Silty Gravel	11-15	NA[d]	0.14(4/94)	EA, 1994
Day Tank 865 Beaufort MCAS, SC	JP-5	1974	60,000	Silty Sand	2-8	7	0.15(5/97)	ABB, 1995b
JP-8 Release Site Pope AFB, NC	JP-8	April 1996	700	Sand	6-9	100	0.01(7/96)	Parsons ES, 1996b

a/ Represents soil type at the capillary fringe/water table.
b/ Feet below ground surface.
c/ Represents depth below ground surface to potentiometric surface.
d/ NA = not available.

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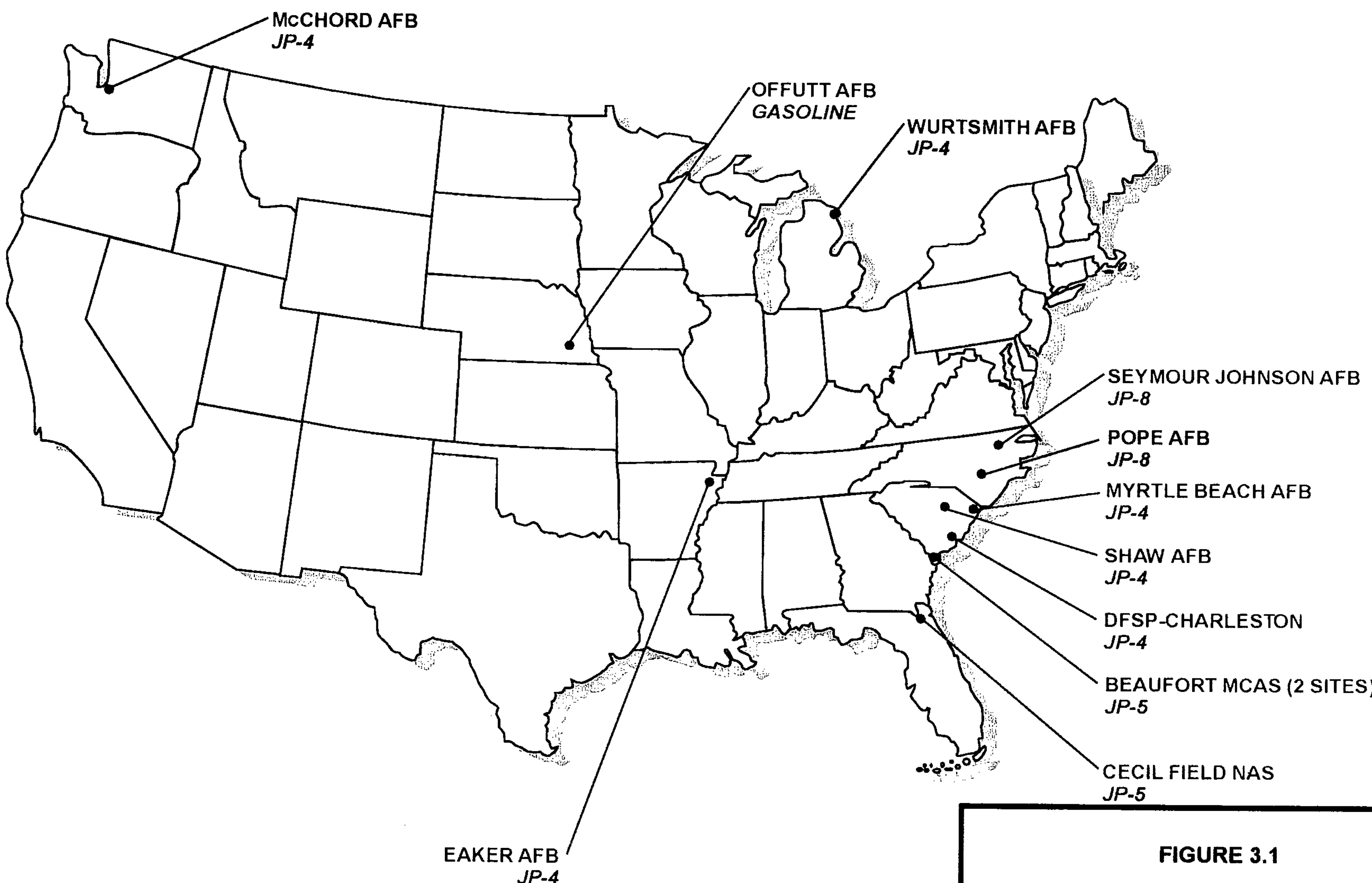

PRIMARY SITES SHOWN IN BLUE
SECONDARY SITES SHOWN IN RED

FIGURE 3.1

LOCATION OF STUDY SITES

Fuel Weathering Study

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

corel\draw\729691b.cdr p2 ma 12998

SECTION 4

COLLECTION OF SITE DATA

To assess the effects of mobile and residual LNAPL weathering as they apply to soil and groundwater, samples of each medium (i.e., soil, groundwater, and mobile LNAPL) were collected from the study sites listed in Table 3.1. Where possible, samples were collected at each site within the area impacted by mobile LNAPL to determine weathering effects on mobile LNAPL and its relation to contaminants in soil at the capillary fringe and in groundwater. Samples collected by Parsons ES during 1997 and 1998 field sampling events form the foundation for this study; however, samples collected prior to 1997 and by other organizations also have been included, where appropriate. Table 4.1 provides a summary of the origin and types of samples collected and analyzed for the eight primary and four secondary fuel weathering study sites.

The following subsections provide a summary of soil, mobile LNAPL, and groundwater collection procedures. A brief description of the laboratory analytical methods used for this study also is provided. The work plan provides further information about sample collection and analysis procedures (Appendix A).

4.1 SOIL SAMPLING METHODS

Soil samples for the study were collected using a truck-mounted Geoprobe®. At most of the selected sites, soil samples were collected from a minimum of two separate borings. To maximize the possibility of obtaining soil samples within areas of measurable mobile LNAPL, boreholes were generally placed as close as possible to monitoring wells displaying maximum mobile LNAPL thickness for the site. Soil samples typically were collected approximately 1 foot above the water table for the purpose of evaluating weathering of residual LNAPL in the capillary fringe

Soil samples were submitted to the US Environmental Protection Agency (USEPA) National Risk Management Research Laboratory (NRMRL) (formerly the Kerr Research Laboratory), in Ada, Oklahoma. Section 4.4 summarizes the soil, mobile LNAPL, and groundwater analytical methods utilized for the study.

4.2 MOBILE LNAPL SAMPLING

Whenever possible, mobile LNAPL samples were collected from two separate site monitoring wells. At the Seymour Johnson AFB and Beaufort MCAS sites, mobile LNAPL was present, and thus collected, at only one site monitoring well. No mobile LNAPL was encountered at the Wurtsmith AFB site.

TABLE 4.1
ORIGIN OF SAMPLE DATA
FUEL WEATHERING STUDY

Site	Date of Sample Collection	Sample Type[a/]	Samples Collected By[b/]	Samples Analyzed By[c/]
Primary Sites				
Tank 349	November 1994	S,GW,FP	USACE/Parsons ES	NRMRL
Offutt AFB, NE	June 1996	GW,FP	Parsons ES	NRMRL
	June 1997	S,GW,FP	Parsons ES	EAL, NRMRL
	October 1998	FP	Parsons ES	EAL, NRMRL
Building 1610	March 1997	S,GW,FP	Parsons ES	EAL, NRMRL
Shaw AFB, SC	March 1998	S,GW,FP	Parsons ES	EAL, NRMRL
Pipeline Leak Site Myrtle Beach AFB, SC	March 1997	S,GW,FP	Parsons ES	EAL, NRMRL
DFSP-Charleston, Tank 1 Area	December 1993	FP	USGS	NRMRL
Hanahan, SC	May 1995	FP	UGSG	NRMRL
	May 1997	S,GW,FP	Parsons ES	EAL, NRMRL
Spill Site No. 2 Eaker AFB, AR	August 1997	S,GW,FP	USACE	EAL, NRMRL
Tank Farm C	May 1997	S,GW,FP	Parsons ES	EAL, NRMRL
Beaufort MCAS, SC	August 1997	FP	Beaufort Personnel	NRMRL
Day Tank 1, Facility 293 Cecil Field NAS, FL	May 1997	S,GW,FP	Parsons ES	EAL, NRMRL
Bldg 4522	July 1996	S,GW,FP	USACE	NRMRL
Seymour Johnson AFB, NC	May 1997	S,GW,FP	Parsons ES	EAL, NRMRL
	March 1998	S,GW,FP	Parsons ES	EAL, NRMRL
Secondary Sites				
KC-135 Crash Site Wurtsmith AFB, MI	August 1996	S,GW	Parsons ES	NRMRL
Washrack/Treatment Area McChord AFB, WA	September 1997	FP	McChord Contractor	NRMRL
Day Tank 865 Beaufort MCAS, SC	May 1997	S,FP	Parsons ES	NRMRL
JP-8 Release Site Pope AFB, NC	July 1996	S,GW,FP	USACE	NRMRL

a/ S = soil; GW = groundwater; FP = free product or mobile LNAPL.
b/ USACE = US Army Corps of Engineers, Kansas City District Office; USGS = United States Geological Survey, Water Resource Division, Columbia, SC.
c/ EAL = Evergreen Analytical Laboratory, Wheat Ridge, Colorado; NRMRL = National Risk Management Research Laboratory, Ada, Oklahoma.

It was originally proposed in the work plan (Appendix A) that mobile LNAPL, groundwater, and soil sampling would be performed in the same vertical continuum within one borehole. It was proposed that groundwater and mobile LNAPL samples would be collected from temporary monitoring points. Attempts were made to collect mobile LNAPL samples from temporary monitoring points at several sites. At these sites, the temporary monitoring points were located within 4 to 7 feet of monitoring wells that contained mobile LNAPL, and were screened to intersect the top of the water table. After monitoring point placement and some initial groundwater purging, the monitoring points were allowed to recharge for up to 15 hours, with the expectation that a sufficient amount of mobile LNAPL (5 to 10 mL) would flow into the monitoring point for sample collection. Only during the 1998 sampling event at Seymour Johnson could a mobile LNAPL sample be collected from a temporary monitoring point. At all other sites no more than a slight sheen of mobile LNAPL was detected in the temporary monitoring points, and mobile LNAPL samples had to be collected from site monitoring wells.

In order to minimize the effects of evaporation on volatile fuel constituents and to obtain samples representative of the mobile LNAPL present in site formations, mobile LNAPL samples generally were collected from site monitoring wells following an initial purging of mobile LNAPL. Because the rate of mobile LNAPL recovery was unknown, a "pre-purge" sample was collected from site monitoring wells in the event that sufficient mobile LNAPL recovery did not occur following initial purging. At most sites, at least one casing-volume of product was removed, and mobile LNAPL recovery was sufficient for "post-purge" sample collection within an hour or less. Other than the "pre-purge" samples from Beaufort Tank Farm C, Beaufort Day Tank 865, and the Cecil Field NAS site (monitoring well CEF-293-7), the mobile LNAPL samples submitted for laboratory analysis were "post-purge" samples. Mobile LNAPL samples were sent to NRMRL and Evergreen Analytical Laboratory (EAL) in Wheat Ridge, Colorado for analysis (Section 4.4).

4.3 GROUNDWATER SAMPLING

Groundwater samples usually were collected from two locations at each of the selected sites. At sites where the water table was less than 20 feet bgs, groundwater samples were collected from temporary monitoring points placed within the Geoprobe® boreholes created during soil sampling. The boreholes and monitoring points generally were placed within 5 to 7 feet of site monitoring wells displaying maximum mobile LNAPL thickness. At sites where the groundwater was more than 20 feet bgs (i.e., Shaw AFB and Offutt AFB), groundwater samples were collected from existing site monitoring wells that contained mobile LNAPL. In addition, at the Seymour Johnson AFB and Cecil Field NAS sites, one groundwater sample also was collected from existing site monitoring wells which contained mobile LNAPL. It is possible that some emulsification of mobile LNAPL may have occurred in groundwater samples collected from these monitoring wells. Groundwater samples were submitted to NRMRL for analysis.

4.4 LABORATORY ANALYSIS

Table 4.2 presents a summary of the analytical methods performed by each laboratory. Analytical results from NRMRL and EAL are provided in Appendix B.

TABLE 4.2
ANALYTICAL PROTOCOLS FOR SOIL, MOBILE LNAPL, AND GROUNDWATER SAMPLES
FUEL WEATHERING STUDY

MATRIX	LABORATORY	NUMBER OF SAMPLES PER SITE	ANALYSIS [a/]	METHOD [b/]
SOIL	NRMRL	2 to 3	BTEX + TMBs Napthalene and Methyl Napthalenes Total Fuel Carbon	NRMRL equivalent to USEPA SW8020A NRMRL equivalent to USEPA SW8270
MOBILE LNAPL	NRMRL	1 to 2	BTEX + TMBs Napthalene and Methyl Napthalenes Density	GC/MS (Direct Injection) NRMRL equivalent to USEPA SW8270 Method 2710F (Standard Methods, 1995)
	EAL	1 to 2	BTEX (Aqueous and Organic Phases)	In accordance with Cline *et al.* (1991)
GROUNDWATER	NRMRL	1 to 2	BTEX + TMBs Napthalene and Methyl Napthalenes	NRMRL equivalent to USEPA E602 NRMRL equivalent to USEPA SW8270

[a/] BTEX = benzene, toluene, ethylbenzene, and total xylenes; TMBs = trimethylbenzene isomers.

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4.4.1 National Risk Management Research Laboratory

NRMRL analyzed soil, groundwater, and mobile LNAPL samples from several study sites. BTEX, naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and the various TMB isomers concentrations were determined for each matrix. In addition, soil samples were analyzed for total fuel carbon, and mobile LNAPL samples were analyzed for fuel density. Samples from the eight primary and four secondary sites (Table 4.1) were submitted to NRMRL for analysis.

4.4.2 Evergreen Analytical Laboratory

EAL analyzed mobile LNAPL samples collected from various study sites in order to determine fuel/water partitioning coefficients (K_{fw}) at equilibrium saturations. The EAL analyses generally were performed in accordance with procedures from the Cline *et al.*(1991) study. Saturated, equilibrium solutions of the collected fuels in contact with distilled, deionized, organic-free water were prepared. Two mL of fuel were added to 40 mL of water in volatile organics analysis vials having Teflon® septa (a 1:20 fuel to water ratio). Sample vials were agitated for approximately 30 minutes, then allowed to rest for 1 hour in an inverted position. Following mixing and stabilization, the aqueous phase and the organic (fuel) phase were analyzed separately for determination of BTEX concentrations by USEPA SW8020 by gas chromatography with photoionization detection (GC/PID).

SECTION 5

ANALYTICAL RESULTS AND DATA ANALYSIS

The primary objective of this study was to determine a range of natural weathering rates for mobile LNAPLs in order to refine modeling assumptions for the contaminant source term. The BTEX compounds were the primary focus of the study as they typically represent the primary contaminants of concern at gasoline and JP-4 fuel release sites. Naphthalene and methylnaphthalenes also were evaluated because these aromatic compounds can represent contaminants of concern at sites contaminated by kerosene-based jet fuels (i.e., JP-5 and JP-8). In addition to the mobile LNAPL weathering analysis, fuel/water partitioning coefficients for BTEX compounds were determined based on field data and compared to laboratory-determined partitioning values. Lastly, residual LNAPL weathering in capillary fringe soils was compared to mobile LNAPL weathering.

5.1 RESULTS SUMMARY

Table 5.1 summarizes mobile LNAPL, groundwater, and soil analytical results for the remaining BTEX fraction based on fuel type and includes sample data from the eight primary and four secondary sites. The mobile LNAPL values shown represent analytical results obtained from EAL and NRMRL. Groundwater and soil analytical results are from NRMRL. A more complete listing of analytical results obtained from EAL and NRMRL for each site, including naphthalene, methylnaphthalene, and TMB results, is provided in Appendix B.

5.1.1 Mobile LNAPL BTEX Results

Mobile LNAPL BTEX results varied considerably with fuel type. Total BTEX concentrations in mobile LNAPL collected at the fuel release sites ranged from 11 mg/mL (JP-5 and JP-8) to 135 mg/mL (gasoline). The most significant variations are apparent in the benzene and toluene fractions, where their concentrations varied over approximately 3 orders of magnitude for the different fuel types. Maximum benzene concentrations of 14 mg/mL, 2.7 mg/mL, 0.25 mg/mL, and 0.02 mg/mL were detected in mobile LNAPL from the gasoline, JP-4, JP-8, and JP-5 fuel release sites, respectively. Maximum toluene concentrations in mobile LNAPL ranged from 0.12 mg/mL at the JP-5 sites to 52 mg/mL at the gasoline site. Order-of-magnitude differences in the mobile LNAPL BTEX concentrations based on fuel type are consistent with differences in BTEX concentrations among the fresh fuels (Figure 2.3).

TABLE 5.1
BTEX CONTENT IN MOBILE LNAPL, GROUNDWATER, AND SOIL RESULTING FROM GASOLINE AND JET FUEL RELEASES
FUEL WEATHERING STUDY

Fuel Type	No. of	Benzene		Toluene		Ethylbenzene		Xylenes		Total BTEX	
Sample Matrix[a/]	Samples	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
JP-4 Jet Fuel											
Mobile LNAPL (mg/mL)[b/]	22	0.00003 - 2.7	0.67	0.00003 - 5.7	1.1	0.00003 - 5.5	1.3	0.0001 - 26	6.3	0.0002 - 35	9.3
Groundwater (mg/L)[c/]	8	0.037 - 8.7	3.1	0.002 - 8.8	1.9	0.077 - 1.2	0.50	0.058 - 8.3	2.7	0.47 - 27	8.2
Soil (mg/kg)[d/]	14	0.006 - 11	1.5	0.006 - 22	2.5	0.006 - 34	5.5	0.018 - 173	25	0.036 - 230	34
JP-5 Jet Fuel											
Mobile LNAPL (mg/mL)	4	0.002 - 0.02	0.013	0.013 - 0.12	0.07	0.12 - 3.2	1.5	0.61 - 7.3	3.4	0.74 - 11	5
Groundwater (mg/L)	2	0.004 - 0.05	0.026	0.023 - 0.11	0.066	0.12 - 0.21	0.16	0.45 - 0.70	0.58	0.60 - 1.1	0.83
Soil (mg/kg)	6	0.012 - 3.3	0.94	0.079 - 19	6.3	1.5 - 155	57	0.093 - 425	145	6.9 - 600	208
JP-8 Jet Fuel											
Mobile LNAPL (mg/mL)	9	0.00003 - 0.25	0.13	0.00003 - 1.6	0.85	0.063 - 1.2	0.93	1.01 - 7.5	4.8	1.1 - 11	6.7
Groundwater (mg/L)	4	0.0005 - 0.85	0.42	0.001 - 4.1	1.8	0.007 - 0.84	0.37	0.067 - 3.2	1.5	0.076 - 9.0	4.1
Soil (mg/kg)	9	0.006 - 13	6.0	0.006 - 79	35	0.006 - 75	38	0.018 - 416	168	0.036 - 561	248
Gasoline											
Mobile LNAPL (mg/mL)	7	0.96 - 14	7.9	12 - 52	36	9.3 - 13	11	33 - 57	43	56 - 135	97
Groundwater (mg/L)	5	9.6 - 38	30	24 - 44	37	3.6 - 4.6	4.1	13 - 18	15	51 - 101	86
Soil (mg/kg)	4	0.56 - 43	26	0.33 - 165	88	0.29 - 59	30	0.79 - 203	102	2.0 - 467	247

[a/] Mobile LNAPL analytical results obtained from EAL and NRMRL. Groundwater and soil analytical results obtained from NRMRL.

[b/] mg/mL = milligrams per milliliter.

[c/] mg/L = milligram per liter.

[d/] mg/kg = milligrams per kilogram.

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5.1.2 Groundwater BTEX Results

Groundwater BTEX analytical results in the LNAPL source area also varied with fuel type. Groundwater concentrations at the gasoline site consistently exceeded USEPA (1996) MCLs for benzene (0.005 mg/L), toluene (1.0 mg/L), ethylbenzene (0.7 mg/L), and total xylenes (10 mg/L). At the jet fuel release sites where the effective solubility of the BTEX compounds in the LNAPL is significantly lower than in gasoline, MCL exceedances were less frequent. Maximum concentrations of benzene measured at the JP-4, JP-5, and JP-8 release sites exceeded the MCL; however, concentrations in some groundwater samples at the JP-5 and JP-8 sites were below the benzene MCL. Even at the JP-4 sites where fuel releases occurred more than 20 years prior to the sampling event, benzene concentrations in groundwater continued to exceed the MCL. Toluene and ethylbenzene concentrations in contaminant source area groundwater at the JP-4 and JP-8 sites occasionally exceeded their MCLs, but no MCL exceedances were observed for these analytes in the two JP-5 site samples. Total xylenes concentrations in groundwater at the JP-4, JP-5, and JP-8 release sites were consistently below the MCL of 10 mg/L, indicating that xylene contamination is not likely to be a significant environmental threat at jet fuel release sites. However, xylene concentrations in groundwater at the gasoline site exceeded the MCL in all samples (Tables 2.1 and 5.1).

5.1.3 Soil BTEX Results

BTEX concentrations detected in capillary fringe soil samples did not vary as significantly with fuel type as did mobile LNAPL and groundwater BTEX concentrations. Maximum benzene concentrations of 43 milligrams per kilogram (mg/kg), 13 mg/kg, 11 mg/kg, and 3.3 mg/kg were measured at the gasoline, JP-8, JP-4, and JP-5 release sites, respectively. Similarly, maximum concentrations of toluene were greatest at the gasoline site (165 mg/kg), followed by the JP-8 sites (79 mg/kg), JP-4 sites (22 mg/kg), and JP-5 sites (19 mg/kg). Surprisingly, maximum soil concentrations of ethylbenzene (155 mg/kg) and total xylenes (425 mg/kg) were detected in the capillary fringe soil sample collected at the Cecil Field NAS JP-5 release site; however, comparatively low concentrations of ethylbenzene and xylenes were detected in the mobile LNAPL sample collected near this location (3.2 mg/mL and 7.3 mg/mL, respectively).

5.2 MOBILE LNAPL WEATHERING

Mobile LNAPL weathering was assessed by evaluating the mass fraction reduction of BTEX. BTEX concentrations in mobile LNAPL samples were compared to conservatively assumed initial BTEX concentrations in fresh fuel. Using the known dates of the product releases and the assumed initial BTEX compositions for the various fuels, the degree of mobile LNAPL weathering (i.e., BTEX mass fraction depletion) that has occurred with time was determined for each release site.

5.2.1 Assumed Initial Fuel Compositions

Initial concentrations of BTEX, naphthalene, and methylnaphthalenes in gasoline, JP-4, JP-5, and JP-8 were conservatively assumed. The assumed initial concentration

for each fuel type is based on the following literature or analytical values presented in Section 2.1.2.4:

- JP-4 - Initial values from Smith *et al.* (1981);
- JP-5 at Cecil Field NAS - Initial values from Hughes *et al.* (1984);
- JP-5 at Beaufort MCAS - Initial values based on Beaufort MCAS fresh JP-5 sample;
- JP-8 - Initial values from Mayfield (1996); and
- Gasoline - Initial values from Ghassemi *et al.* (1984).

Further discussion of the assumed fuel compositions for JP-4, JP-5, JP-8, and gasoline in relation to site-specific mobile LNAPL results is presented in Sections 5.2.3, 5.2.4, 5.2.5, and 5.2.6, respectively.

5.2.2 Kinetics of Weathering

As discussed in Section 2, LNAPL weathering in the subsurface environment results from a complex combination of physical, chemical, and biological processes. Weathering rates, or compound-specific depletion rates, are a function of these processes, and influenced by many variables. In view of this, the reaction kinetics that determine the rate of contaminant depletion are difficult to predict. For this study, no literature findings were identified that explained reaction kinetics for the overall weathering of a mobile LNAPL, and for most sites, only one or two data points were available for estimating contaminant depletion rates. Because of these limitations, contaminant depletion in this study was evaluated using both zero-order and first-order reaction kinetics.

5.2.2.1 Zero-Order Weathering

Zero-order weathering or decay is described by the following differential equation:

$$dC / dt = -k_0 \qquad \text{eq. 5.1}$$

As shown on Figure 5.1, zero-order weathering assumes that contaminant depletion in the mobile LNAPL occurs at a constant rate (k_0). In addition, the rate of depletion of the contaminant is not reduced as the contaminant becomes increasingly more depleted with time and weathering of the mobile LNAPL. Solving this differential equation gives:

$$C = C_0 - k_0 t \qquad \text{eq. 5.2}$$

where: C = contaminant concentration (wt%) at time "t"

C_0 = contaminant concentration (wt%) at time "zero"

k_0 = zero-order rate constant or slope (wt% per year)

Solving for k_0, eq. 5.2 can be written as:

$$k_0 = (C_0 - C) / t \qquad \text{eq. 5.3}$$

For zero-order weathering, the amount or percent of annual contaminant depletion can be compared to the concentration at time zero (C_0) by the following:

$$\%\ C_0 \text{ Reduced / Year} = \frac{[(C_0 - C) / C_0] \times 100}{\text{Sample Date - Spill Date (years)}} \qquad \text{eq. 5.4}$$

5.2.2.2 First-Order Weathering

First-order decay or weathering is described by the following differential equation:

$$dC / dt = - k_1 t \qquad \text{eq. 5.5}$$

As shown on Figure 5.2, the rate of contaminant depletion changes with time under the first-order weathering assumption. Under this scenario, the rate of contaminant depletion is proportional to the amount of contaminant that is present at any time "t." The first-order weathering curve shown on Figure 5.2 is an exponential curve, where the amount of contaminant remaining in the LNAPL approaches zero with time, but never reaches a zero concentration. Solving this differential equation gives:

$$C = C_0 e^{-k_1 t} \qquad \text{eq. 5.6}$$

where: C = contaminant concentration in wt% at time "t"

C_0 = contaminant concentration in wt% at time "zero"

e = base of natural logarithms (approximately 2.72)

k_1 = first-order rate constant (years^{-1} or 1/years)

Solving for k_1, eq. 5.6 can be written as:

$$k_1 = - \ln (C/C_0) / t \qquad \text{eq. 5.7}$$

For first-order weathering, the yearly percent of contaminant depletion can be determined as follows:

$$\%\ \text{Reduction / Year} = (1 - e^{-k_1 t}) \times 100 \qquad \text{eq. 5.8}$$

As discussed in Sections 2.3.1 and 2.3.2, the dissolution and volatilization of a compound is controlled by the amount (mole fraction) of that compound in the LNAPL under equilibrium conditions. Therefore, the rate of contaminant depletion resulting from dissolution or volatilization also may be proportional to the contaminant concentration, indicating first-order weathering may be more appropriate especially if one of these weathering mechanisms predominates.

FIGURE 5.1
EXAMPLE OF ZERO-ORDER CONTAMINANT WEATHERING
FUEL WEATHERING STUDY

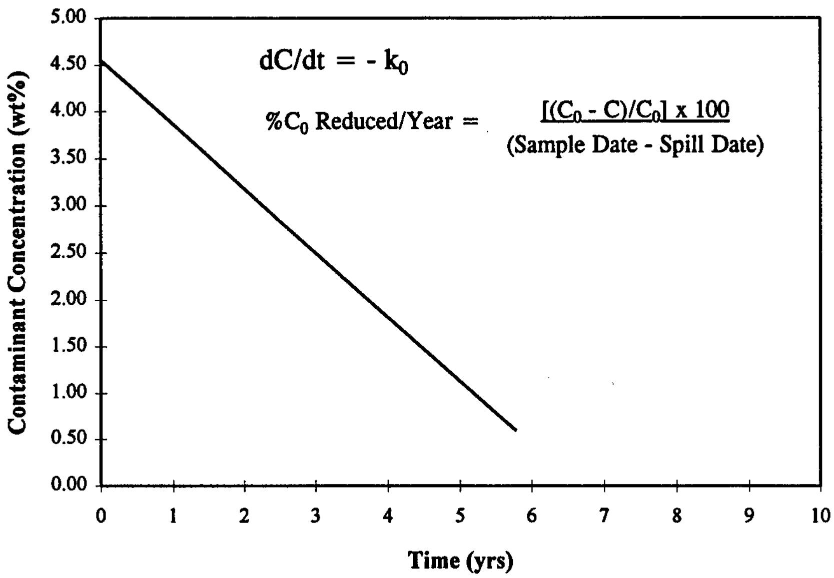
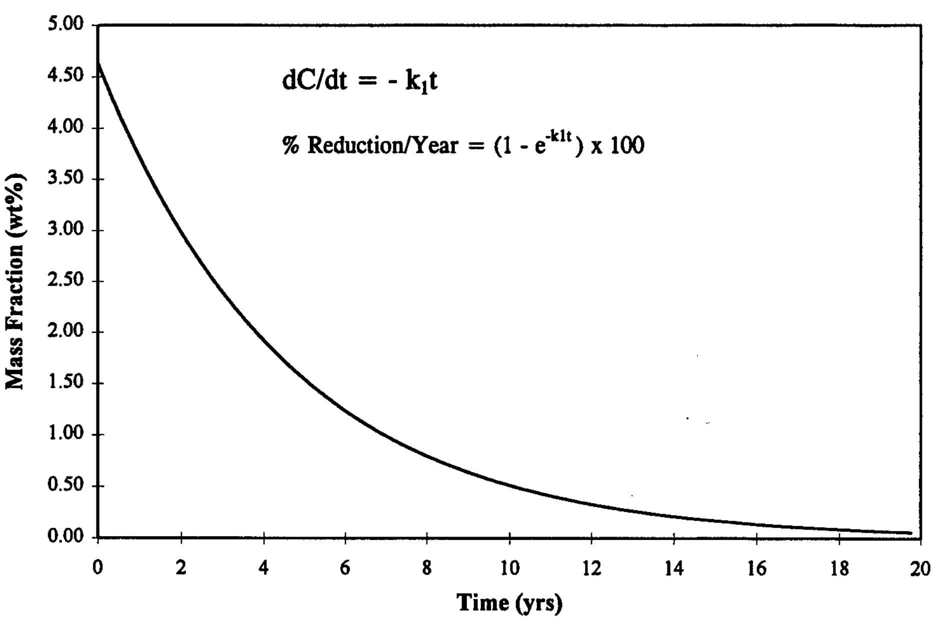


FIGURE 5.2
EXAMPLE OF FIRST-ORDER CONTAMINANT WEATHERING
FUEL WEATHERING STUDY



5.2.3 Weathering in JP-4 Mobile LNAPL

Weathering rates or depletion rates for the BTEX and naphthalene compounds were evaluated at five JP-4 release sites with spill ages ranging between approximately 4 and 24 years. At the Myrtle Beach, Eaker, and McChord AFB sites, only one sampling event was performed. At the Shaw AFB and DFSP-Charleston sites, analytical data from more than one sampling event were evaluated.

Initial composition values for JP-4 were assumed to be equivalent to concentrations reported by Smith *et al.* (1981). For each of the BTEX compounds, composition values presented by Smith *et al* (1981) are slightly lower than the values presented by Hughes *et al.* (1984) (Figure 2.3), and therefore more conservative for use in estimating BTEX depletion. However, it should be noted that the Hughes *et al.* (1984) study considered a larger sample database than the Smith *et al.* (1981) study, and is considered the preeminent study on JP-4 jet fuel composition.

5.2.3.1 Range of Weathering Rates for the Five JP-4 Sites

Mobile LNAPL weathering rates for the JP-4 sites were determined for every BTEX, naphthalene, and methylnaphthalene sample result independent of results from other sampling events. For this analysis, rate constants k_0 and k_1 were determined for each sample result by solving equations 5.3 and 5.7. Annual reductions based on zero-order and first-order weathering assumptions were determined for each sample result by solving equations 5.4 and 5.8, respectively. Because these calculations can be performed knowing the contaminant concentration at only one-point in time relative to the known spill date, weathering rates determined using this method are hereafter referred to as "one-point" weathering rates.

Using this method, each sample result was given equal weight, and average BTEX and naphthalene weathering rates can be determined for each site. In addition, weathering rates at sites where only one sampling event was performed could be compared to sites where multiple sampling events were performed. BTEX and naphthalene weathering rates in JP-4 mobile LNAPL determined using the one-point method are summarized in Table 5.2. As shown, minimum, maximum, and average values for the rate constants k_0 and k_1 and annual contaminant reduction rates based on zero-order and first-order weathering are provided. In addition, assumed initial concentrations (Smith *et al.*, 1981) and average remaining concentrations are shown for comparison.

As shown on Table 5.2, the weathering rates determined for each site can vary significantly between the LNAPL samples analyzed. Reasons for this variability include differences in mobile LNAPL concentrations with different sample locations at the site, and differences in analytical results obtained by EAL and NRMRL for the same sample. Because of this inherent variability, the average BTEX and naphthalene reduction rates shown on Table 5.2 have been used to represent weathering rates at each site.

Based on the mobile LNAPL sample results shown, the average zero-order BTEX weathering rates range from 0.5 to 20 %/yr, and naphthalene and methylnaphthalene zero-order weathering rates range from 0.8 to 25 %/yr. The average first-order BTEX

TABLE 5.2

BTEX AND NAPHTHALENE (ONE-POINT)[a] WEATHERING RATES IN JP-4 MOBILE LNAPL

FUEL WEATHERING STUDY

Site	Approximate	Number of	Assumed Initial	Average Remaining	ZERO ORDER						FIRST ORDER					
			Conc. (C_o)[c]	Conc. (C)	Rate Constant k_0[e]			% C_o Reduced/Year[f]			Rate Constant k_1[g]			% Reduction/Year[h]		
Analyte	Spill Age[b]	Samples	(wt%)[d]	(wt %)	min	max	avg	min	max	avg	min	max	avg	min	max	avg
Shaw AFB, SC	**4 years**															
Benzene		6	0.50	0.23	0.06	0.12	0.08	11	23	17	0.13	0.38	0.25	12	31	22
Toluene		6	1.33	0.48	0.21	0.37	0.26	16	27	20	0.21	0.51	0.33	19	40	28
Ethylbenzene		6	0.37	0.16	0.05	0.09	0.06	14	24	17	0.17	0.41	0.26	16	34	23
Total Xylenes		6	2.32	1.07	0.31	0.52	0.39	13	23	17	0.17	0.35	0.24	16	30	22
Total BTEX		6	4.52	1.94	0.64	1.10	0.80	14	24	18	0.18	0.40	0.27	16	33	23
Naphthalene		4	0.50	0.16	0.09	0.13	0.11	18	26	21	0.29	0.44	0.35	25	36	29
1- Methylnaphthalene		4	0.78	0.16	0.16	0.23	0.19	21	30	25	0.40	0.63	0.49	33	47	39
2- Methylnaphthalene		4	0.56	0.27	0.07	0.12	0.09	13	22	16	0.18	0.34	0.23	17	29	21
Myrtle Beach AFB, SC	**16 years**															
Benzene		3	0.50	0.02	0.03	0.03	0.03	5.8	6.1	5.9	0.18	0.26	0.21	16	23	19
Toluene		3	1.33	0.00[i]	0.08	0.08	0.08	6.2	6.2	6.2	0.44	0.46	0.45	36	37	36
Ethylbenzene		3	0.37	0.17	0.01	0.02	0.01	2.1	4.9	3.4	0.03	0.10	0.06	2.5	9.1	5.3
Total Xylenes		3	2.32	0.57	0.09	0.13	0.11	3.9	5.4	4.7	0.06	0.13	0.09	6.0	12	8.9
Total BTEX		3	4.52	0.76	0.21	0.26	0.23	4.6	5.7	5.1	0.09	0.16	0.12	8.3	14	11
Naphthalene		2	0.50	0.14	0.02	0.02	0.02	4.3	4.7	4.5	0.07	0.09	0.08	7.0	8.6	7.8
1- Methylnaphthalene		2	0.78	0.17	0.04	0.04	0.04	4.8	4.8	4.8	0.09	0.09	0.09	8.9	8.9	8.9
2- Methylnaphthalene		2	0.56	0.25	0.02	0.02	0.02	3.4	3.6	3.5	0.05	0.05	0.05	4.8	5.2	5.0
DFSP-Charleston, SC	**22 years**															
Benzene		6	0.50	0.00[i]	0.02	0.03	0.02	4.6	5.5	4.8	0.15	0.55	0.45	14	43	35
Toluene		6	1.33	0.01	0.06	0.07	0.06	4.5	5.5	4.8	0.18	0.41	0.29	17	34	25
Ethylbenzene		6	0.37	0.10	0.00	0.02	0.01	1.3	4.8	3.6	0.02	0.16	0.09	1.5	15	8.7
Total Xylenes		6	2.32	0.44	0.07	0.12	0.09	3.2	5.1	3.9	0.05	0.18	0.10	4.9	17	9.3
Total BTEX		6	4.52	0.55	0.17	0.24	0.19	3.7	5.2	4.3	0.07	0.20	0.12	6.7	18	11
Naphthalene		4	0.50	0.08	0.02	0.02	0.02	3.7	4.9	4.2	0.07	0.12	0.09	6.4	11	9.0
1- Methylnaphthalene		4	0.78	0.19	0.03	0.03	0.03	3.5	4.2	3.7	0.07	0.08	0.07	6.4	7.5	6.7
2- Methylnaphthalene		4	0.56	0.24	0.01	0.02	0.02	2.6	3.3	2.9	0.04	0.05	0.04	3.7	4.9	4.2
Eaker AFB, AR	**24 years**															
Benzene		3	0.50	0.13	0.01	0.02	0.02	2.0	4.2	3.1	0.03	0.30	0.13	2.7	26	12
Toluene		3	1.33	0.04	0.05	0.06	0.05	3.8	4.2	4.0	0.10	0.54	0.39	9.3	42	31
Ethylbenzene		3	0.37	0.47	---[j]	0.00	0.00	---	0.5	---	---	0.01	---	---	0.5	---
Total Xylenes		3	2.32	2.03	---	0.07	0.01	---	3.0	0.5	---	0.05	0.01	---	5.0	1.3
Total BTEX		3	4.52	2.67	0.00	0.15	0.08	0.0	3.3	1.7	0.00	0.06	0.03	0.0	6.1	2.9
Naphthalene		2	0.50	0.13	0.02	0.02	0.02	3.0	3.1	3.1	0.05	0.06	0.06	5.2	5.5	5.4
1- Methylnaphthalene		2	0.78	0.25	0.02	0.02	0.02	2.7	3.1	2.9	0.04	0.06	0.05	4.2	5.4	4.8
2- Methylnaphthalene		2	0.56	0.45	0.00	0.01	0.00	0.3	1.4	0.8	0.00	0.02	0.01	0.3	1.6	1.0

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TABLE 5.2 (Continued)

BTEX AND NAPHTHALENE (ONE-POINT)[a] WEATHERING RATES IN JP-4 MOBILE LNAPL

FUEL WEATHERING STUDY

Site			Assumed Initial	Average Remaining	ZERO ORDER						FIRST ORDER					
	Approximate	Number of	Conc. (C_o)[c]	Conc. (C)	Rate Constant k_0 [e]			% C_o Reduced/Year [f]			Rate Constant k_1 [g]			% Reduction/Year [h]		
Analyte	Spill Age[b]	Samples	(wt%) [d]	(wt %)	min	max	avg	min	max	avg	min	max	avg	min	max	avg
McChord AFB, WA	22 years															
Benzene		1	0.50	0.00[i]			0.02			4.5			0.54			42
Toluene		1	1.33	0.00[i]			0.06			4.5			0.58			44
Ethylbenzene		1	0.37	0.00[i]			0.02			4.5			0.53			41
Total Xylenes		1	2.32	0.00[i]			0.10			4.5			0.56			43
Total BTEX		1	4.52	0.00[i]			0.20			4.5			0.56			43
Naphthalene		1	0.50	0.00[i]			0.02			4.5			0.54			42
1- Methylnaphthalene		1	0.78	0.02			0.03			4.4			0.18			16
2- Methylnaphthalene		1	0.56	0.01			0.02			4.4			0.16			15

Note: Calculated values shown have been rounded.

[a] Analyte weathering rates in free-phase product calculated based on assumed initial analyte concentrations in fresh JP-4 fuel and one point in time free-phase product sample results.

[b] Approximate age of spill as of the most recent sampling event.

[c] Assumed initial concentrations from Smith et al. (1981).

[d] wt% = weight percent.

[e] k_0 = zero-order rate contstant or slope calculated using equation 5.3; units in weight percent per year.

[f] Annual mass fraction reduction as a percent of the initial concentration; calculated using equation 5.4.

[g] k_1 = first-order rate constant or exponential decay rate calculated using equation 5.7; units in $years^{-1}$ or 1/years.

[h] Weight percent reduction per year calculated using equation 5.8.

[i] Result indicates a nondetect or near nondetect value; as appropriate, weathering rate calculations for this result were based on the method detection limit.

[j] --- = negative value; measured concentration is greater than the assumed initial concentration.

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weathering rates range from 1.3 to 44 %/yr, and naphthalene and methylnaphthalene first-order weathering rates range from 1.0 to 42 %/yr. The annual zero-order reduction rates are consistently lower than corresponding first-order rates. This phenomenon occurs uniformly for all data sets presented in this study, due to the inherent nature of the rate calculations. Greater degradation rates are required for first-order weathering to obtain the same end concentration because first-order weathering is concentration dependent. Zero-order weathering assumes that the concentration of a compound is depleted at a constant rate regardless of contaminant concentration.

First-order weathering rates that were calculated using nondetect or near nondetect values for C are significantly higher than reduction rates shown for more moderate compound depletion. This was particularly evident at the McChord AFB site where virtually no BTEX or naphthalenes were detected in a single sample collected 24 years following the fuel release. For this site, first-order reduction rates were estimated at more than 40 %/yr. This occurrence emphasizes a potential limitation of using a single sample collected several years after the fuel release to estimate weathering rates. Use of a 40 %/yr weathering rate or similar rate determined from nondetect or near nondetect concentrations may overestimate contaminant source-term reductions for fate and transport modeling. (Note: When nondetect concentrations were observed during this study, weathering rates were calculated as if the compound was detected at the method detection limit.)

As shown on Table 5.2, the range of average weathering rates were significant for the BTEX and naphthalene compounds. If the bias of high first-order weathering rates at McChord AFB are excluded, the highest weathering rates were measured at the Shaw AFB site. At this site, the average zero-order total BTEX weathering rate was 18 %/yr, and average zero-order naphthalene/methylnaphthalene rates were 16 to 25 %/yr. Average first-order weathering rates were higher, with 23 %/yr BTEX reduction and 21 to 39 %/yr naphthalene and methylnaphthalenes reduction.

The lowest weathering rates were apparent at the Eaker AFB site where the average total BTEX reduction rate was 1.7 %/yr and 2.9 %/yr for zero-order and first-order weathering, respectively. The second lowest average weathering rates were measured for the DFSP-Charleston site where the total BTEX reduction rate was 4.3 %/yr for zero-order weathering and 11 %/yr for first-order weathering. The low reduction rates at the Eaker AFB site result from one mobile LNAPL sample in which BTEX concentrations were minimally depleted relative to the assumed initial concentration values. The sample in question was collected near the original fuel release source area, a fuel pipeline that was not abandoned until 1995. The minimal amount of weathering at this location 24 years following the reported fuel release may indicate that environmental conditions are not conducive to aromatic hydrocarbon depletion at this location. However, it seems more likely that the source area sample collected from the Eaker AFB site is from a more recent, undocumented fuel release. At DFSP-Charleston, the average total BTEX concentration in mobile LNAPL approximately 22 years after the fuel release (0.55 wt%) is approximately one-fifth the average total BTEX concentration in mobile LNAPL from the Eaker AFB site (2.67 wt%).

5.2.3.2 Combining JP-4 Site Data to Assess Weathering Rates

Very few fuel release sites have sufficient data available to determine the progression of mobile LNAPL BTEX depletion from the time of spill release until the time of complete BTEX removal. However, comparing and compiling data from all JP-4 sites, regardless of differences in hydrogeologic effects, provides some insight into the relationship between BTEX depletion in mobile LNAPL and spill age. Figure 5.3 represents a plot obtained when average total BTEX concentrations in mobile LNAPL from the five primary JP-4 sites are compiled into one weathering plot. Similarly, Figure 5.4 represents a compilation of average benzene data from the five JP-4 sites.

Zero-order and first-order curves were fitted to the plotted data to evaluate BTEX weathering in mobile LNAPL with time. Considering the combined data from the five JP-4 sites, the first-order curves appear to better match the general trend of the data. As shown in Figure 5.3, the zero-order curve greatly underestimates total BTEX depletion in the first 4 years following a JP-4 release as indicated by the Shaw AFB site data. Total BTEX depletion in mobile LNAPL at the Myrtle Beach AFB and DFSP-Charleston sites, 16 and 18 years after their respective JP-4 releases, also are underestimated by the zero-order curve, but to a lesser degree. Conversely, the first-order curve provides a reasonable approximation for the rapid depletion of BTEX initially observed at Shaw AFB. The benzene first-order curve shown in Figure 5.4 provides a reasonably good approximation of benzene weathering in mobile LNAPL at the five JP-4 sites. As illustrated by Figures 5.3 and 5.4, the Eaker AFB average concentrations for total BTEX and benzene appear to better match that expected for a spill release that is between 1 and 5 years old, not 24 years old.

Considering the total BTEX and benzene mobile LNAPL data for the JP-4 sites taken as a whole, the first-order curves shown in Figures 5.3 and 5.4 provide default values for total BTEX and benzene weathering, respectively. Based on these results, it appears that a default first-order rate for total BTEX weathering from JP-4 mobile LNAPL could be assumed to be approximately 16 %/yr. If the Eaker data is not considered, the first-order total BTEX weathering rate is approximately 20 %/yr (Figure 5.3). For benzene weathering, a first-order weathering rate of approximately 26 %/yr is estimated considering all the JP-4 site data. If the Eaker data is excluded, the mobile LNAPL benzene weathering rate is approximately 32 %/yr. The zero-order rates shown on Figures 5.3 and 5.4 generally are less affected by the exclusion of the Eaker AFB site data.

5.2.3.3 Dissolution-Dominated Weathering

JP-4 site data suggests that BTEX mobile LNAPL weathering rates at the JP-4 sites is predominantly a function of dissolution. As discussed in Sections 2.3.1 and 2.3.2, dissolution and volatilization of LNAPL compounds are a function of their concentration in the mobile LNAPL. As concentrations in the mobile LNAPL decrease, the compound depletion rate decreases. This Raoult's Law behavior is apparent in the first-order weathering trend illustrated by Figures 5.3 and 5.4. Applied to this study, it appears that the decreased BTEX depletion rate with time and weathering, is likely the result of ever decreasing BTEX dissolution flux to groundwater and/or ever decreasing BTEX volatilization flux to soil gas.

FIGURE 5.3
TOTAL BTEX WEATHERING CONSIDERING AVERAGE DATA FROM THE JP-4 RELEASE SITES
FUEL WEATHERING STUDY

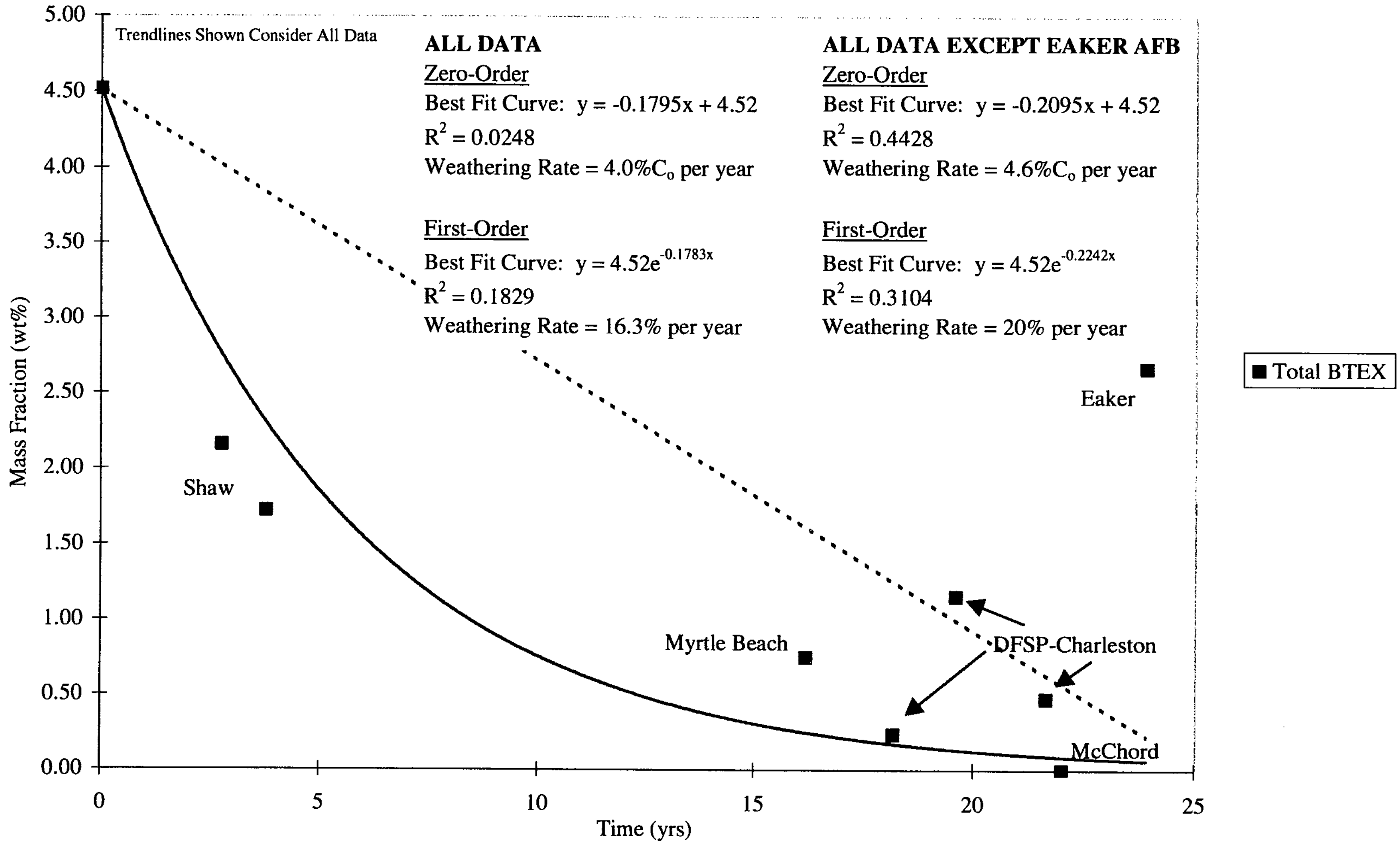

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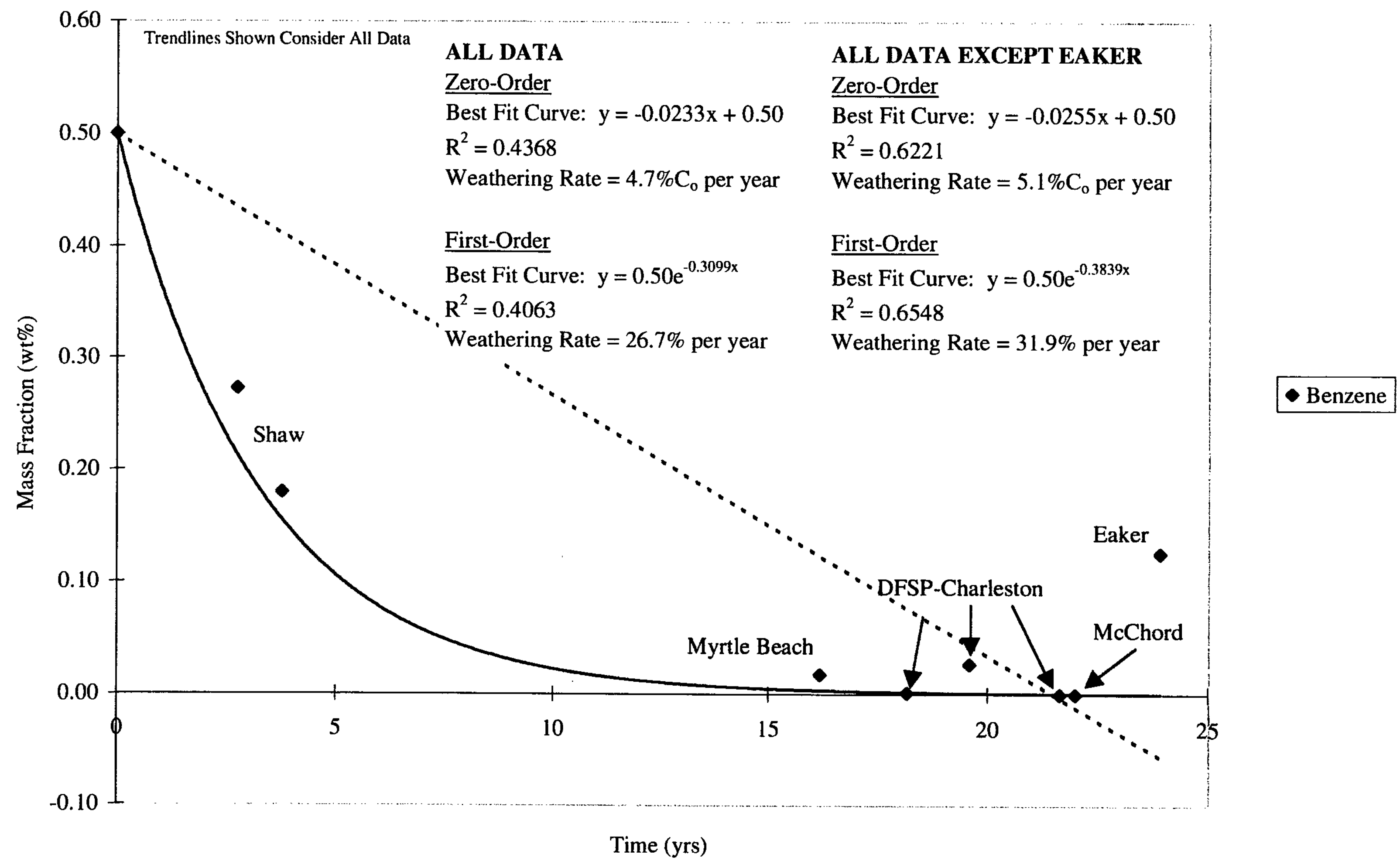
FIGURE 5.4
BENZENE WEATHERING CONSIDERING AVERAGE DATA FROM THE JP-4 RELEASE SITES
FUEL WEATHERING STUDY



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A comparison of weathering rates among compounds and among sites (Table 5.2) indicates that dissolution may be the predominant weathering mechanism acting to reduce chemical concentrations in mobile LNAPL. Benzene and toluene weathering rates generally are higher than ethylbenzene and xylene weathering rates. Also, weathering rates for xylenes are generally higher than ethylbenzene weathering rates. One possible explanation for this is dissolution-dominated weathering where benzene, toluene, and xylenes are more rapidly reduced in mobile LNAPL than is ethylbenzene because of their higher effective water solubilities (Table 2.1).

A comparison of BTEX weathering rates at the various JP-4 sites also indicates that BTEX weathering may be dominated by dissolution. At the Eaker AFB site, evidence of minimal BTEX weathering 24 years following the reported JP-4 release may be confounded by a more recent fuel release. Assuming the mobile LNAPL at the Eaker AFB site is actually 3 years old, the total BTEX concentration in the source area (3.5 wt%) still is much higher than that at the Shaw AFB site (1.94 wt%) 3 to 4 years following release. One likely explanation for the higher BTEX concentration and lower mobile LNAPL weathering rate at the Eaker AFB site is the significantly lower groundwater velocities that have been observed at this site. Under equilibrium conditions, lower groundwater velocities would create a lower dissolution flux for mobile LNAPL depletion (Section 2.4.2). As shown on Table 3.1, the Eaker AFB site has the lowest estimated groundwater velocity, 16 feet per year (ft/yr) of the four sites where groundwater velocity and mobile LNAPL data are available. Significantly higher groundwater velocities have been observed at the Shaw AFB (400 ft/yr), Myrtle Beach AFB (420 ft/yr), and DFSP-Charleston (62 ft/yr) sites. No information was obtained regarding groundwater velocity for the McChord AFB site; however, high precipitation rates in the Seattle/Tacoma area (Figure 3.1) are likely to enhance BTEX dissolution, much the same way as high groundwater velocity.

5.2.3.4 Weathering and Spill Age

As shown on Table 5.2, mobile LNAPL weathering rates for total BTEX generally decrease with increasing spill age. This is particularly evident comparing the average total BTEX reduction rates at the Shaw AFB, Myrtle Beach AFB, DFSP-Charleston, and Eaker AFB sites. Average zero-order reduction rates for total BTEX were estimated as 18, 5.1, 4.3, and 1.7 %/yr, respectively, for these four sites. Average first-order weathering rates for total BTEX were measured as 23, 11, 11, and 2.9 %/yr, respectively. A similar trend of decreasing weathering rates with spill age also was apparent for the naphthalene compounds. However, first-order benzene depletion from JP-4 mobile LNAPL does not appear to be significantly influenced by spill age as indicated by the average benzene data shown on Table 5.2 and in Figure 5.4. Benzene data from the Shaw AFB, Myrtle Beach AFB, and DFSP-Charleston sites all indicate that benzene depletion in excess of 19 %/yr (first-order) occurs during the first 20 years of mobile LNAPL weathering.

5.2.3.5 Site-Specific Weathering Based on Multiple Sampling Events

At the Shaw AFB and DFSP-Charleston sites, mobile LNAPL samples were collected from the same site monitoring wells during multiple sampling events. At the Shaw AFB site, mobile LNAPL samples were collected from site monitoring wells approximately 3 years and 4 years after the JP-4 release (Table 4.1). At the DFSP-

Charleston site, mobile LNAPL samples were collected from site monitoring wells approximately 18 years, 20 years, and 22 years following the fuel release. For these two sites, BTEX concentrations detected in mobile LNAPL during these sampling events were plotted with the assumed initial BTEX concentrations in fresh JP-4 jet fuel (Smith *et al.*, 1981). A simple best-fit regression analysis was then performed on the plotted data to determine zero-order and first-order weathering rate constants and BTEX reduction rates.

5.2.3.5.1 Shaw AFB

BTEX weathering in JP-4 mobile LNAPL at the Shaw AFB site assuming zero-order and first-order decay are presented on Figures 5.5 and 5.6, respectively. As shown on the figures, rate constants (k_0 and k_1) and reduction rates were determined using analytical results from EAL and NRMRL. Zero-order and first-order rates estimated based on the NRMRL sample results were slightly higher than rates determined using the EAL results. This is attributable to the fact that the BTEX concentrations in mobile LNAPL as determined by EAL always were slightly higher than the NRMRL results.

Figure 5.5 suggests that zero-order BTEX reduction at the Shaw AFB site approximately 4 years after the fuel release is occurring at 13 to 18 %/yr (based on the more conservative EAL data). Figure 5.6 suggests that first-order BTEX reduction is occurring at 17 to 26 %/yr (based on EAL data). Consistent with the one-point weathering analysis (Table 5.2), weathering rates in mobile LNAPL appear to be most significant for toluene. Weathering results presented on Figures 5.5 and 5.6 suggest that benzene weathering is second-most significant, followed by ethylbenzene and xylenes. The average zero-order and first-order reduction rates shown in Table 5.2 for the Shaw AFB site provide a good estimate of the amount of BTEX depletion occurring in mobile LNAPL at monitoring well MW1610-2.

Comparing Figures 5.5 and 5.6, both the zero-order and first-order weathering rate assumptions appear to be valid for the limited data shown. No conclusions can be reached regarding whether zero-order or first-order weathering more accurately depicts BTEX depletion in mobile LNAPL at the Shaw AFB site. Nonetheless, the data plotted in Figures 5.5 and 5.6 demonstrate that the initial BTEX concentration assumption (i.e., values determined by Smith *et al.* [1981]) for JP-4 is reasonable. For some of the weathering rate curves shown on Figures 5.5 and 5.6, coefficient of determination (R^2) values measured as high as 1.0, indicating no variance between the data and the predictive trend line (see Appendix C).

5.2.3.5.2 DFSP-Charleston

Zero-order and first-order BTEX weathering for the DFSP-Charleston site based on mobile LNAPL samples results at extraction well EW-6 are presented on Figures 5.7 and 5.8, respectively. Weathering rates shown on these two figures were determined using NRMRL analytical results. Zero-order rates for mobile LNAPL collected from EW-6 (Figure 5.7) are slightly higher than the average rates shown on Table 5.2. However, first-order rates shown on Figure 5.8 are substantially higher than the average rates shown on Table 5.2. The high total BTEX depletion rate shown on Figure 5.8 is a result of complete or near complete depletion of benzene and toluene from the EW-6 mobile LNAPL sample collected in 1997. The actual progression

FIGURE 5.5
ZERO-ORDER BTEX WEATHERING IN JP-4 MOBILE LNAPL AT MW1610-2
BUILDING 1610, SHAW AFB, SOUTH CAROLINA
FUEL WEATHERING STUDY

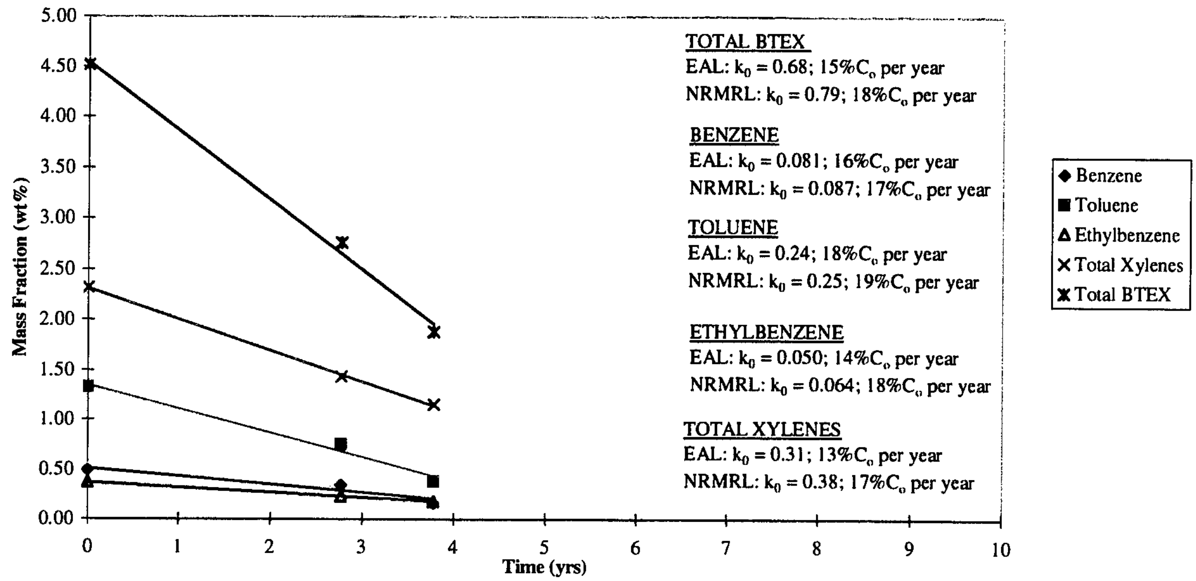


FIGURE 5.6
FIRST-ORDER BTEX WEATHERING IN JP-4 MOBILE LNAPL AT MW1610-2
BUILDING 1610, SHAW AFB, SOUTH CAROLINA
FUEL WEATHERING STUDY

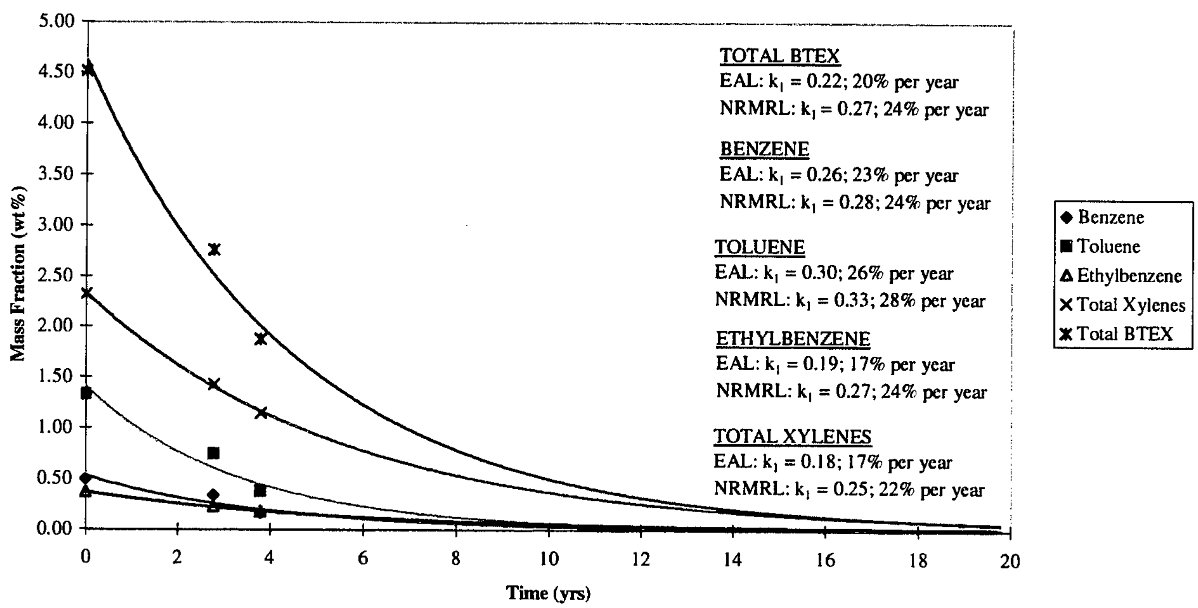


FIGURE 5.7
ZERO-ORDER BTEX WEATHERING IN JP-4 MOBILE LNAPL AT EW-6
TANK 1, DFSP-CHARLESTON, SOUTH CAROLINA
FUEL WEATHERING STUDY

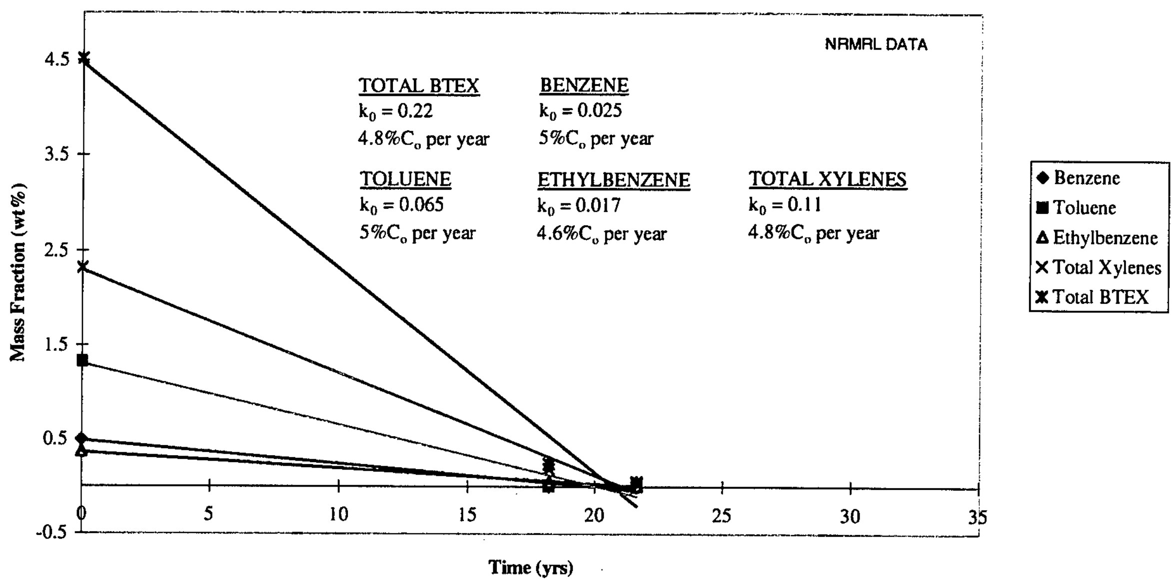
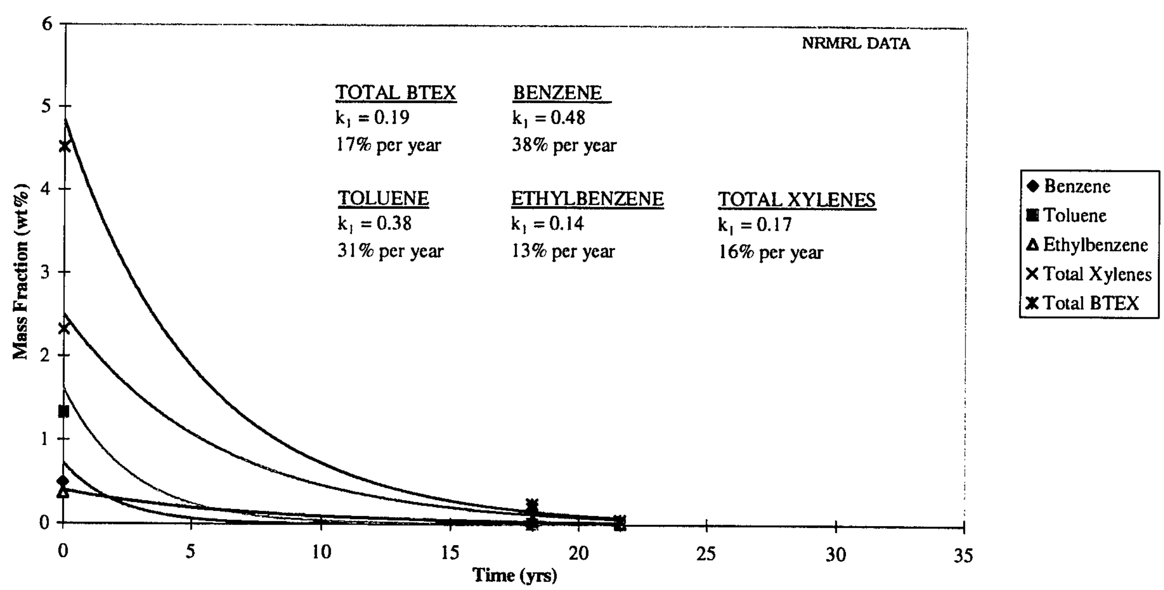


FIGURE 5.8
FIRST-ORDER BTEX WEATHERING IN JP-4 MOBILE LNAPL AT EW-6
TANK 1, DFSP-CHARLESTON, SOUTH CAROLINA
FUEL WEATHERING STUDY



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("shape") of the BTEX weathering curves cannot be determined from the limited data shown on Figures 5.7 and 5.8. However, it is evident from these plots that BTEX compounds have been almost completely removed from mobile LNAPL in the vicinity of EW-6.

Comparing total BTEX weathering in samples collected from three wells at the DFSP-Charleston site provides some insight into the spatial differences possible in mobile LNAPL weathering (Figure 5.9). Assuming first-order weathering, total BTEX reductions at the DFSP-Charleston site appear to range from 7 to 17 %/yr depending upon sample location. A review of the DFSP-Charleston site data did not provide any indication as to why the total BTEX weathering rates vary to this degree. Each of these monitoring wells is located downgradient from the original spill location and within approximately 70 feet of each other. Extraction well EW-6 does not appear to be located in a different hydrogeologic setting relative to monitoring wells MW-103 and WQ27B. However, visual observations of mobile LNAPL samples collected in May 1997 indicated that the mobile LNAPL from EW-6 was darker in color and likely more weathered than the sample collected from MW-103. This underscores the importance of collecting several mobile LNAPL samples from each site so that an average weathering rate can be calculated.

5.2.4 Weathering in JP-5 Mobile LNAPL

Weathering rates for BTEX, naphthalene, and methylnaphthalene compounds were evaluated at two JP-5 release sites: Beaufort MCAS and Cecil Field NAS. One mobile LNAPL sampling event was performed at each site during May 1997. The approximate spill ages during this sampling event were 7 years for the Beaufort MCAS site and 16 years for the Cecil Field NAS site.

Assumed initial concentrations of BTEX, naphthalene, and methylnaphthalenes in fresh JP-5 were based on two data sets. For the Beaufort MCAS site, the initial mobile LNAPL concentrations were assumed to equal concentrations detected by NRMRL in a fresh JP-5 sample from Beaufort MCAS. For the Cecil Field NAS site, the initial mobile LNAPL concentrations were assumed to equal concentrations reported by Hughes *et al.* (1984) for fresh JP-5.

BTEX, naphthalene, and methylnaphthalene weathering rates at the two JP-5 sites were evaluated using one-point weathering rates based on equations 5.3 and 5.7 for zero-order weathering, and equations 5.4 and 5.8 for first-order weathering. Table 5.3 shows the results of this analysis.

5.2.4.1 Beaufort MCAS

At the Beaufort MCAS site, zero-order and first-order weathering rates were found to range between 4.1 and 8.2 %/yr and 4.7 and 12 %/yr, respectively, for the target compounds. Because the benzene concentrations detected in mobile LNAPLs at the site were higher than the assumed initial concentration, no weathering rate constants or reduction rates could be determined for this compound. The estimated reduction rates for toluene, ethylbenzene, and xylenes indicate that these compounds are being depleted from JP-5 mobile LNAPL at approximately the same rate. As shown in Table 5.3, assumed initial concentrations and average remaining concentrations for xylenes are

FIGURE 5.9
COMPARISON OF FIRST-ORDER TOTAL BTEX WEATHERING AT THREE WELLS
DFSP-CHARLESTON, SOUTH CAROLINA
FUEL WEATHERING STUDY

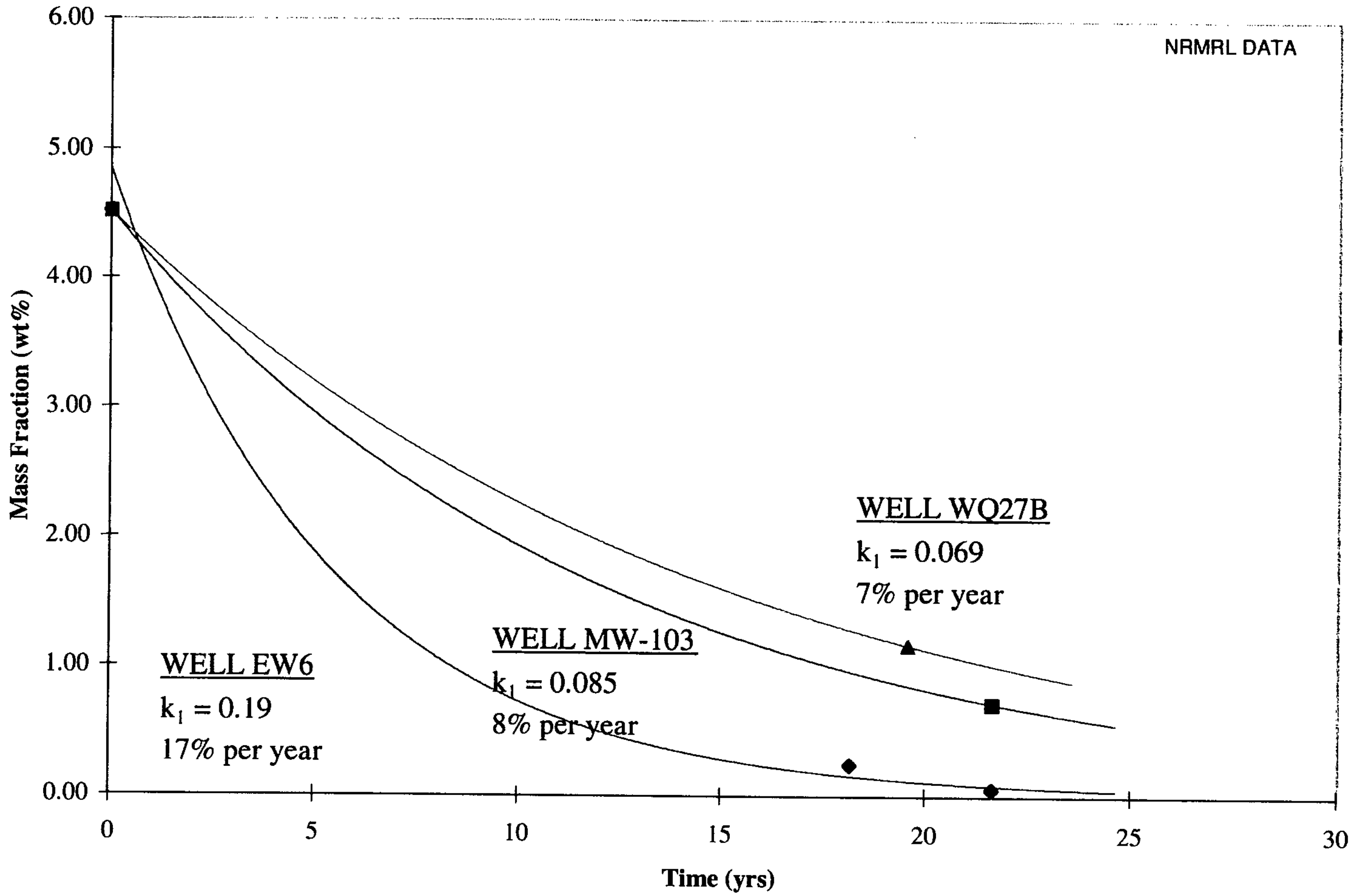

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TABLE 5.3

BTEX AND NAPHTHALENE (ONE-POINT)[a/] WEATHERING RATES IN JP-5 MOBILE LNAPL

FUEL WEATHERING STUDY

Site / Analyte	Approximate Spill Age[b/]	Number of Samples	Assumed Initial Conc. (C_o)[c/] (wt%)[d/]	Average Remaining Conc. (C) (wt%)	ZERO ORDER: Rate Constant k_0[e/]	ZERO ORDER: %Co Reduction/Year[f/]	FIRST ORDER: Rate Constant k_1[g/]	FIRST ORDER: % Reduction/Year[h/]
Beaufort Tank Farm C, SC	**7 years**							
Benzene		2	0.0002	0.0003	---[i/]	---	---	---
Toluene		2	0.0047	0.0021	0.0004	7.8	0.117	11
Ethylbenzene		2	0.042	0.017	0.003	8.2	0.126	12
Total Xylenes		2	0.24	0.10	0.019	8.0	0.125	12
Total BTEX		2	0.29	0.12	0.023	**8.1**	0.124	**12**
Naphthalene		1	0.12	0.06	0.009	7.4	0.105	9.9
1- Methylnaphthalene		1	0.23	0.16	0.009	4.1	0.048	4.7
2- Methylnaphthalene		1	0.29	0.19	0.015	5.1	0.064	6.2
Cecil Field NAS, FL	**16 years**							
Benzene		2	0	0.003	---	---	---	---
Toluene		2	0	0.02	---	---	---	---
Ethylbenzene		2	0	0.36	---	---	---	---
Total Xylenes		2	0.02	0.76	---	---	---	---
Total BTEX		2	0.02	1.13	---	---	---	---
Naphthalene		1	0.89	0.24	0.041	4.6	0.083	8.0
1- Methylnaphthalene		1	0.27	0.29	---	---	---	---
2- Methylnaphthalene		1	0.45	0.42	0.002	0.51	0.005	0.53

Note: Calculated values shown have been rounded.

a/ Analyte weathering rates in free-phase product calculated based on an assumed initial concentrations in fresh JP-5 jet fuel and one point in time free-phase product sample results.

b/ Approximate age of the spill as of the most recent sampling event.

c/ For Beaufort MCAS results, the assumed initial concentration of analytes is equal to the NRMRL concentration for a fresh JP-5 sample collected from Beaufort MCAS in May 1997. For Cecil Field results, Hughes et al. (1984) JP-5 composition values were used.

d/ wt% = weight percent.

e/ k_0 = zero-order rate contstant or slope calculated using equation 5.3; units in weight percent per year.

f/ Annual mass fraction reduction as a percent of the initial concentration; calculated using equation 5.4.

g/ k_1 = first-order rate constant or exponential decay rate calculated using equation 5.7; units in years^{-1} or 1/years.

h/ Weight percent reduction per year calculated using equation 5.8.

i/ --- = negative value; measured concentration is greater than assumed initial concentration.

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approximately 2 orders of magnitude higher than the toluene concentrations, and 1 order of magnitude higher than the ethylbenzene concentrations. Nonetheless, concentrations for each of these compounds are well below their respective concentrations in JP-4 (Figure 2.3). In view of these significantly lower fresh fuel and mobile LNAPL concentrations, groundwater MCLs for toluene, ethylbenzene, and xylenes are unlikely to be exceeded by partitioning of these compounds from the fuel into site groundwater (Section 5.1.2).

BTEX, naphthalene, and methylnaphthalene weathering rates at the Beaufort Tank Farm C site generally fall within the same range as the JP-4 rates shown in Table 5.2 for these compounds. A rough interpolation of the average JP-4 reduction rates shown in Table 5.2 for Shaw AFB (a 4-year old spill) and Myrtle Beach AFB (a 16-year old spill) would give rates comparable to those determined for JP-5 at the Beaufort Tank Farm C site (a 7-year old spill).

5.2.4.2 Cecil Field NAS

At the Cecil Field NAS site, weathering rates could be estimated only for naphthalene and 2-methylnaphthalene. Mobile LNAPL concentrations for all other analytes exceeded the assumed initial values. Relative to the naphthalene and 2-methylnaphthalene rates shown for the Beaufort MCAS site, estimated reduction rates at the Cecil Field NAS site are substantially lower.

5.2.5 Weathering in JP-8 Mobile LNAPL

Weathering rates for BTEX, naphthalene, and methylnaphthalene compounds were evaluated at two JP-8 release sites: Pope AFB and Seymour Johnson AFB. One mobile LNAPL sampling event was performed at the Pope AFB site in July 1996 approximately 3 months after the fuel release. Three mobile LNAPL sampling events were performed at the Seymour Johnson AFB site in the first 2.25 years following the fuel release.

5.2.5.1 Pope AFB

Approximately 3 months after the JP-8 release at Pope AFB, the US Army Corps of Engineers (USACE) collected one mobile LNAPL sample for analysis by NRMRL. No benzene or toluene were detected in the mobile LNAPL sample and ethylbenzene and xylenes concentrations were reduced approximately 90 percent compared to assumed initial concentrations. Zero-order and first-order reduction rates were calculated based on this one sample result; however, the nondetect or near nondetect concentrations of BTEX in the sample prevented meaningful determination of LNAPL weathering. Compared to the other fuel release sites, a relatively small volume (700 gallons) of fuel was released at the Pope AFB site (Table 3.1) and no free-phase product was evident at the site approximately 6 months after the fuel release (Dalzell, 1997). It appears that significant volatilization may have immediately reduced the BTEX fraction of the small spill.

5.2.5.2 Seymour Johnson AFB

One-point weathering rates determined for the Seymour Johnson AFB site are presented in Table 5.4. Weathering rates presented in Table 5.4 are based on eight samples collected over approximately 2 years from one monitoring well. As with the JP-4 data shown in Table 5.2, the estimated weathering rates calculated from the Seymour Johnson AFB samples vary significantly. The average reduction rates suggest that weathering is slowest for ethylbenzene, most likely as a result of its lower effective water solubility (effective water solubility values for JP-8 were not identified in the literature; however, the relative effective water solubility values for the BTEX compounds are expected to be very similar to those shown on Table 2.1 for JP-4 and gasoline).

Mobile LNAPL sample results from the multiple sampling events and zero-order and first-order analysis of the Seymour Johnson JP-8 data are shown in Figures 5.10 and 5.11, respectively. Similar to the JP-4 weathering results, zero-order and first-order rates estimated based on the NRMRL analytical results were slightly higher than rates determined from the EAL results. EAL data used to estimate reduction rates were collected during two sampling events. NRMRL rates are based on data from three sampling events (Table 4.1).

Figure 5.10 indicates that zero-order reduction rates during 2.25 years of product weathering range from 6 %/yr for ethylbenzene to 33 %/yr for benzene (based on EAL and NRMRL data). The overall BTEX zero-order reduction rates were estimated to be 22 %/yr based on the EAL data and 27 %/yr based on NRMRL data. Figure 5.11 suggests that first-order reduction for the BTEX compounds is occurring at 6 to 52 %/yr (considering EAL and NRMRL data). The total BTEX first-order decay rates were 26%/yr for the EAL data and 36%/yr for the NRMRL data. Weathering rates in the JP-8 mobile LNAPL also appear to support the presumption that mobile LNAPL weathering is dissolution-dominated for the aromatic compounds. Compound-specific reduction rates are highest for benzene, followed by toluene, xylenes, and ethylbenzene. Other observations include:

- Average one-point rate values shown in Table 5.4 appear to be relatively conservative compared to the rates determined from best-fit analyses of the site data shown on Figures 5.10 and 5.11;
- The initial assumed BTEX concentrations for JP-8 (Mayfield, 1996) are well supported by the analytical results plotted on Figures 5.10 and 5.11; and
- Both zero-order and first-order BTEX weathering rates appear to be valid during the first 2 years of mobile LNAPL weathering.

5.2.6 Weathering in Gasoline Mobile LNAPL

BTEX weathering analysis in gasoline mobile LNAPL was evaluated at the Offutt AFB site. Compared to the other fuel weathering sites, where the dates of the fuel release are known with some confidence, mobile LNAPL at the Offutt AFB site most likely is the result of chronic, long-term leaking from former USTs which ended in

TABLE 5.4

BTEX AND NAPHTHALENE (ONE-POINT)[a/] WEATHERING RATES IN JP-8 MOBILE LNAPL

FUEL WEATHERING STUDY

Site			Assumed Initial	Average Remaining	ZERO ORDER						FIRST ORDER					
	Approximate	Number of	Conc. (C_o)[c/]	Conc. (C)	Rate Constant k_0 [e/]			%Co Reduction/Year [f/]			Rate Constant k_1 [g/]			% Reduction/Year [h/]		
Analyte	Spill Age[b/]	Samples	(wt%) [d/]	(wt%)	min	max	avg	min	max	avg	min	max	avg	min	max	avg
Seymour Johnson AFB, NC	**2 years**															
Benzene		8	0.03	0.02	0.00	0.01	0.01	5.7	36	**23**	0.06	0.76	0.39	5.6	53	**29**
Toluene		8	0.21	0.12	0.00	0.06	0.05	2.1	28	23	0.02	0.46	0.32	2.1	37	27
Ethylbenzene		8	0.15	0.13	—[i/]	0.04	0.01	—	23	6.6	---	0.29	0.08	—	25	7.2
Total Xylenes		8	1.13	0.67	0.16	0.33	0.27	15	30	24	0.16	0.49	0.33	15	39	28
Total BTEX		8	1.52	0.94	0.21	0.43	0.34	14	28	**22**	0.15	0.45	0.30	14	36	**25**
Naphthalene		4	0.25	0.13	0.06	0.34	0.13	24	39	28	0.29	0.95	0.48	25	61	36
1- Methylnaphthalene		4	0.43	0.17	0.05	0.16	0.12	19	38	31	0.24	0.56	0.45	22	43	35
2- Methylnaphthalene		4	0.35	0.26	0.04	0.10	0.06	11	22	15	0.12	0.31	0.19	11	27	17

Note: Calculated values shown have been rounded.

[a/] Analyte weathering rates in free-phase product calculated based on assumed initial analyte concentrations in fresh JP-8 fuel and one point in time free-phase product sample results.

[b/] Approximate age of spill as of the most recent sampling event.

[c/] Assumed initial concentrations from Mayfield, 1996.

[d/] wt% = weight percent.

[e/] k_0 = zero-order rate contstant or slope calculated using equation 5.3; units in weight percent per year.

[f/] Annual mass fraction reduction as a percent of the initial concentration; calculated using equation 5.4.

[g/] k_1 = first-order rate constant or exponential decay rate calculated using equation 5.7; units in $years^{-1}$ or 1/years.

[h/] Weight percent reduction per year calculated using equation 5.8.

[i/] --- = negative value; measured concentration is greater than the assumed initial concentration.

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FIGURE 5.10
ZERO-ORDER BTEX WEATHERING IN JP-8 MOBILE LNAPL AT MW-1S
BUILDING 4522, SEYMOUR JOHNSON AFB, NORTH CAROLINA
FUEL WEATHERING STUDY

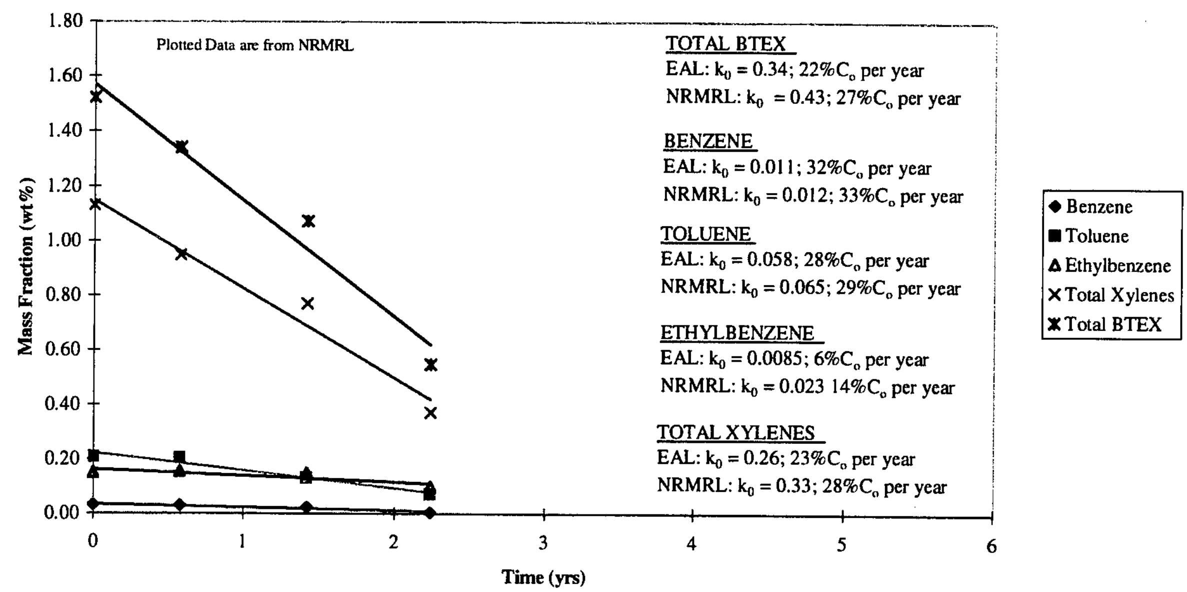
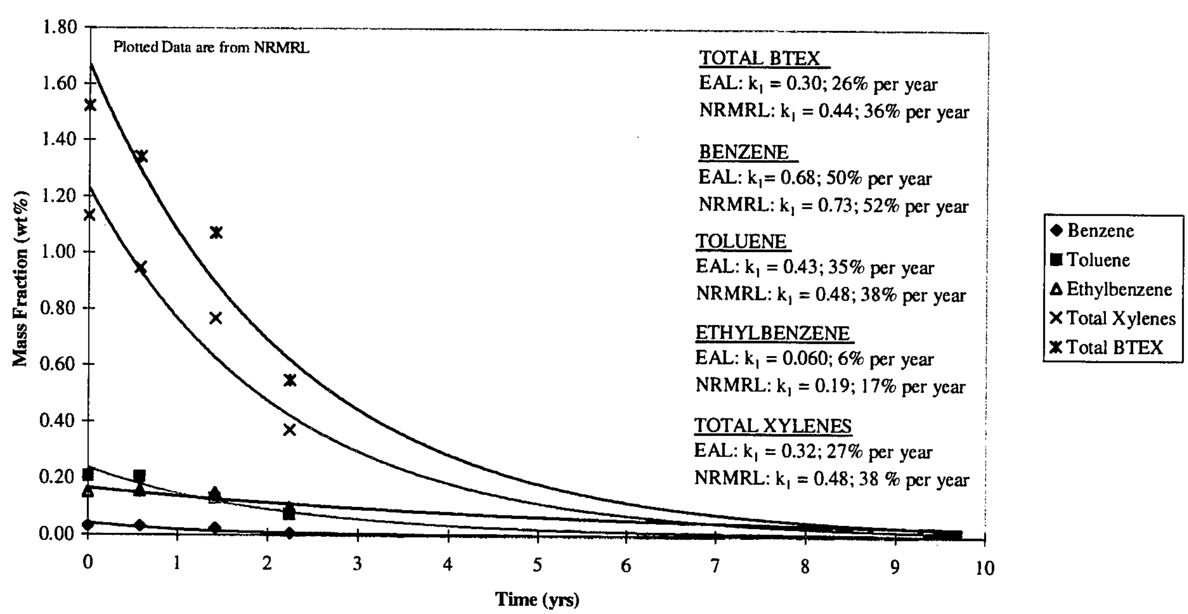


FIGURE 5.11
FIRST-ORDER BTEX WEATHERING IN JP-8 MOBILE LNAPL AT MW-1S
BUILDING 4522, SEYMOUR JOHNSON AFB, NORTH CAROLINA
FUEL WEATHERING STUDY



1990 when the gasoline tanks were closed. The Offutt AFB site was selected for the study because of the existence of historical BTEX analytical results for mobile LNAPL.

5.2.6.1 One-Point Weathering Rates

BTEX one-point weathering rates for the Offutt AFB site are presented in Table 5.5. Rates provided in this table were calculated from BTEX analytical results for each of four LNAPL sampling events conducted following closure of the source USTs. Initial BTEX concentrations were assumed to be equal to those determined by Ghassemi *et al.* (1984) for fresh gasoline. Initial evaluation of the site weathering rates indicated significant variability by sampling location; therefore, one-point weathering rates are presented in Table 5.5 for the individual monitoring wells from which mobile LNAPL samples were collected.

Comparison of the mobile LNAPL sample results with the assumed initial concentrations in fresh gasoline indicates that the mobile LNAPL at the Offutt AFB site is only slightly weathered. The most significant BTEX reductions in mobile LNAPL were observed in the sample collected from MW349-8 approximately 6 years after tank closure. At this location, greater than 90 percent of the benzene was depleted from the mobile LNAPL, and the total BTEX concentration was reduced by approximately 50 percent. Higher weathering rates (i.e. lower analyte concentrations) at MW349-7 and MW349-8 relative to MW349-1 may be the result of their locations further from the original source area. Mobile LNAPL at wells MW349-7 and MW349-8 likely is older than that at MW349-1. In all cases, benzene and toluene appear to have weathered at faster rates than xylenes and ethylbenzene. Little to no reduction in ethylbenzene concentrations has occurred in mobile LNAPL at the site. Relatively low groundwater velocities and resulting lower dissolution potential at the Offutt AFB site may be a primary reason for the lower BTEX weathering rates (Table 3.1).

5.2.6.2 Weathering Rates Based on Multiple Sampling Events

At Offutt AFB monitoring well MW349-1, mobile LNAPL samples were collected in November 1994, June 1996, June 1997, and October 1998 to assess changes in BTEX concentrations. Mass fraction (wt%) analytical results from these sampling events are plotted on Figures 5.12 and 5.13. On Figure 5.12, the initial BTEX concentrations determined by Ghassemi *et al.* (1984) for fresh gasoline were assumed to equal the concentrations in mobile LNAPL at the time of tank closure. In Figure 5.13, the initial BTEX values were assumed to equal mid-range values based on gasoline compositional data from AD Little (1987), Sigsby *et al.* (1987), and Potter (1988). Zero-order weathering rates were assumed for both plots.

As is evident on Figures 5.12 and 5.13, the best-fit linear curves and resulting BTEX weathering rates are predominantly controlled by the assumed initial compound concentrations. The analytical results from the four mobile LNAPL sampling events do not clearly indicate a weathering trend for any of the BTEX compounds. Also, the unknown age of the mobile LNAPL at monitoring well MW349-1 and the wide range of possible BTEX concentrations in the original fuel hindered assessment of weathering rates at this location.

TABLE 5.5

BTEX (ONE-POINT)[a] WEATHERING RATES IN GASOLINE MOBILE LNAPL

TANK 349, OFFUTT AFB, NEBRASKA

FUEL WEATHERING STUDY

Time Since Tank Closure [b] / Analyte	Assumed Initial Concentration (C_o)[c] (wt%)[d]	Remaining Concentration (C) (wt%)		ZERO ORDER: Rate Constant k_0[e]		ZERO ORDER: %C_o Reduced/Year[f]		FIRST ORDER: Rate Constant k_1[g]		FIRST ORDER: % Reduction/Year[h]	
4.5 years		MW349-1	MW349-7	MW349-1	MW349-7	MW349-1	MW349-7	MW349-1	MW349-7	MW349-1	MW349-7
Benzene	1.5	1.1	0.8	0.08	0.17	5.7	11	0.07	0.15	6.3	14
Toluene	5.9	5.6	3.9	0.07	0.45	1.3	7.7	0.01	0.09	1.3	9.0
Ethylbenzene	1.3	1.4	1.3	---[i]	0.01	---	0.75	---	0.01	---	0.76
Total Xylenes	5.9	5.7	5.7	0.04	0.05	0.75	0.81	0.01	0.01	0.76	0.82
Total BTEX	14.6	13.8	11.6	0.18	0.68	1.2	4.6	0.01	0.05	1.3	5.0
6 years		MW349-1	MW349-8	MW349-1	MW349-8	MW349-1	MW349-8	MW349-1	MW349-8	MW349-1	MW349-8
Benzene	1.5	1.2	0.1	0.06	0.23	3.7	15	0.04	0.40	4.1	33
Toluene	5.9	5.0	1.7	0.14	0.70	2.4	12	0.03	0.21	2.6	19
Ethylbenzene	1.3	1.6	1.4	---	---	---	---	---	---	---	---
Total Xylenes	5.9	5.2	4.4	0.11	0.25	1.9	4.2	0.02	0.05	2.0	4.7
Total BTEX	14.6	13.0	7.5	0.27	1.16	1.8	8.0	0.02	0.11	1.9	10
7 years		MW349-1	MW349-6	MW349-1	MW349-6	MW349-1	MW349-6	MW349-1	MW349-6	MW349-1	MW349-6
Benzene	1.5	1.2	1.3	0.05	0.03	3.3	1.8	0.04	0.02	3.6	1.9
Toluene	5.9	5.6	5.6	0.05	0.04	0.83	0.66	0.01	0.01	0.85	0.68
Ethylbenzene	1.3	1.5	1.8	---	---	---	---	---	---	---	---
Total Xylenes	5.9	6.0	6.1	---	---	---	---	---	---	---	---
Total BTEX	14.6	14.2	14.8	0.05	---	0.37	---	0.00	---	0.38	---
8 years		MW349-1	MW349-6	MW349-1	MW349-6	MW349-1	MW349-6	MW349-1	MW349-6	MW349-1	MW349-6
Benzene	1.5	1.0	0.3	0.06	0.14	3.8	9.1	0.05	0.17	4.5	16
Toluene	5.9	4.8	3.4	0.13	0.29	2.2	4.9	0.02	0.06	2.4	6.2
Ethylbenzene	1.3	1.6	1.4	---	---	---	---	---	---	---	---
Total Xylenes	5.9	6.1	6.1	---	---	---	---	---	---	---	---
Total BTEX	14.6	13.6	11.2	0.12	0.40	0.85	2.8	0.01	0.03	0.88	3.1

Note: Calculated values shown have been rounded.

[a] Analyte weathering rates in free-phase product calculated based on assumed initial analyte concentrations in fresh gasoline and one point in time free-phase product results.

[b] Approximate time between date USTs were taken out of service and date of sampling event.

[c] Ghassemi *et al*., 1984.

[d] wt% = weight percent.

[e] k_0 = zero-order rate contstant or slope calculated using equation 5.3; units in weight percent per year.

[f] Annual mass fraction reduction as a percent of the initial concentration; calculated using equation 5.4.

[g] k_1 = first-order rate constant or exponential decay rate calculated using equation 5.7; units in years^{-1} or 1/years.

[h] Weight percent reduction per year calculated using equation 5.8.

[i] --- = negative value; measured concentration is greater than the assumed initial concentration.

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FIGURE 5.12
BTEX WEATHERING IN GASOLINE MOBILE LNAPL ASSUMING INITIAL CONCENTRATIONS FROM GHASSEMI *et al.* (1984)
TANK 349, OFFUTT AFB, NEBRASKA
FUEL WEATHERING STUDY

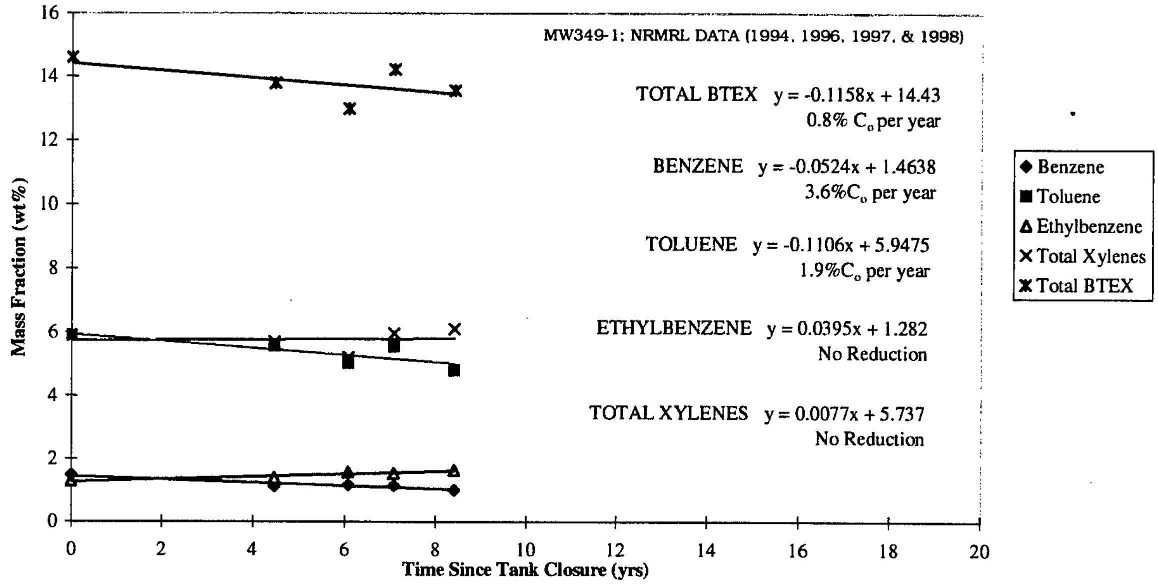
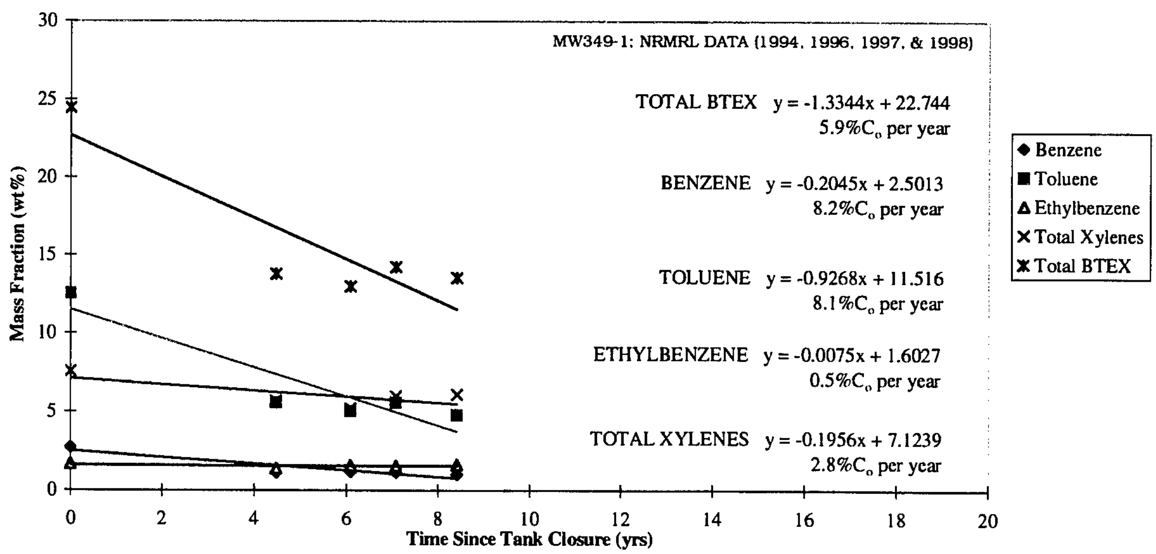


FIGURE 5.13
BTEX WEATHERING IN GASOLINE MOBILE LNAPL ASSUMING INITIAL CONCENTRATIONS EQUAL MID-RANGE VALUES FROM AD LITTLE (1987), SIGSBY et al. (1987), AND POTTER (1988)
TANK 349, OFFUTT AFB, NEBRASKA
FUEL WEATHERING STUDY



One possible explanation for the lack of an observed weathering trend in the analytical data is the fact that the 4.5- and 6-year mobile LNAPL samples were collected from monitoring well MW349-1 without first purging the monitoring well. As shown in Table 5.5, the lower BTEX concentrations during the 4.5- and 6-year monitoring events may be the result of evaporative losses of BTEX while the mobile LNAPL sat in the monitoring well. If only the June 1997 (year 7) and October 1998 (year 8) mobile LNAPL data are considered, reductions in benzene, toluene, and total BTEX concentrations can be used to estimate initial mobile LNAPL concentrations at the time of tank closure. Figures 5.14 and 5.15 provide reduction rates in mobile LNAPL at MW349-1 based on zero-order and first-order back-calculations, respectively. Based on this analysis, rates of total BTEX reduction in mobile LNAPL at MW349-1 appear to be most similar to that observed at the Eaker AFB site (Table 5.2). At both the Eaker AFB site and the Offutt AFB site, slower groundwater velocities may be responsible for the lower BTEX weathering rates observed in mobile LNAPL.

5.3 FUEL/WATER PARTITIONING COEFFICIENTS (K_{FW})

Mobile LNAPL and groundwater data from the eight primary sites selected for the study were used to determine "field" and "laboratory" fuel/water partitioning coefficients (K_{fw}) for the BTEX compounds. Recall that in Section 2.3.1.2, K_{fw} is defined as the concentration of a compound in fuel (C_f) divided by its equilibrium concentration in water in contact with the fuel (C_w) (equation 2.2). The "field" K_{fw} was calculated using groundwater and mobile LNAPL analytical results from NRMRL. The "laboratory" K_{fw} values were determined using mobile LNAPL samples in a laboratory partitioning experiment performed by EAL in accordance with procedures outlined by Cline *et al.* (1991) with the purpose of creating equilibrium conditions (Section 4.4.2). The "field" and "laboratory" K_{fw}s were determined to evaluate the validity of the equilibrium assumption (Section 2.3.1.3) when performing dissolution modeling. Values for K_{fw} determined from field and laboratory data are presented in Table 5.6.

The EAL ("laboratory") K_{fw} values for the BTEX compounds were expected to be lower than the NRMRL ("field") K_{fw} values because laboratory mixing and dissolution was expected to produce maximum or equilibrium concentrations in deionized water in contact with the fuel LNAPL. However, the "field" K_{fw} values determined from mobile LNAPL and actual groundwater results generally are lower than the "laboratory" values. Of the ten field and laboratory data sets presented in Table 5.6, only data from the Myrtle Beach AFB and Offutt AFB sites generally conformed to the initial prediction. For the other sites, the field K_{fw} values for the BTEX compounds were generally lower than the laboratory values indicating higher BTEX concentrations in groundwater than in the deionized water analyzed after a laboratory equilibrium procedure. The comparison of field and laboratory data generally suggest that dissolution in site groundwater samples collected from within the mobile LNAPL source area may be more complete (i.e., closer to equilibrium) than the results obtained from the laboratory partitioning experiment. The lower than expected concentrations in the aqueous phase samples analyzed by EAL as compared to the NRMRL groundwater results possibly could be partially attributed to various water solubility effects (including pH, temperature, pressure, salinity) and differences in analytical methods.

FIGURE 5.14
1997 AND 1998 ZERO-ORDER BTEX WEATHERING IN GASOLINE MOBILE LNAPL AT MW349-1
TANK 349, OFFUTT AFB, NEBRASKA
FUEL WEATHERING STUDY

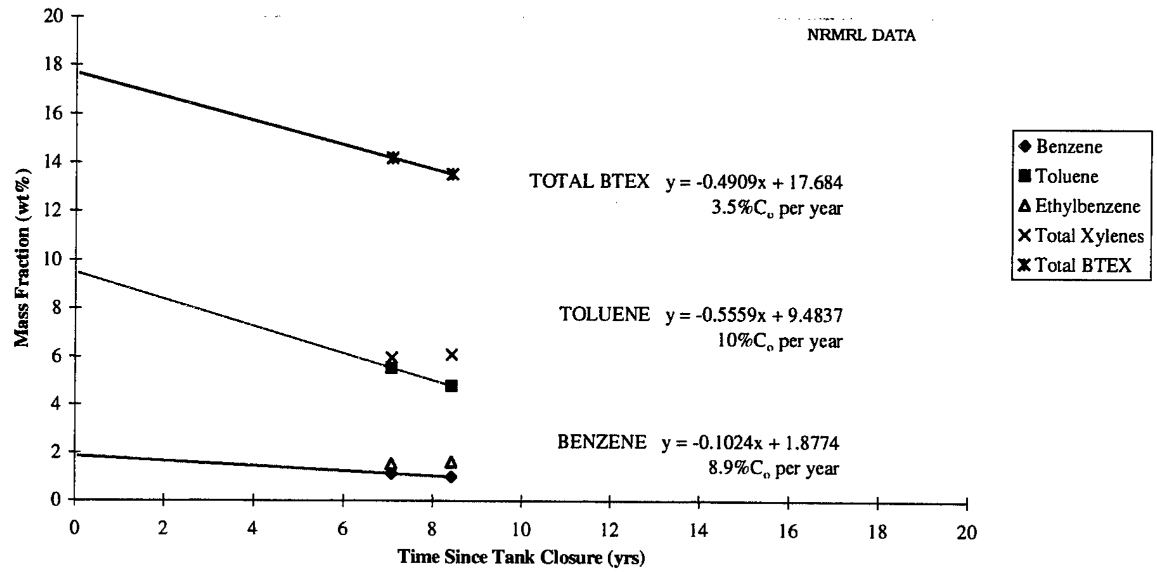


FIGURE 5.15
1997 AND 1998 FIRST-ORDER BTEX WEATHERING IN GASOLINE MOBILE LNAPL AT MW349-1
TANK 349 OFFUTT AFB, NEBRASKA
FUEL WEATHERING STUDY

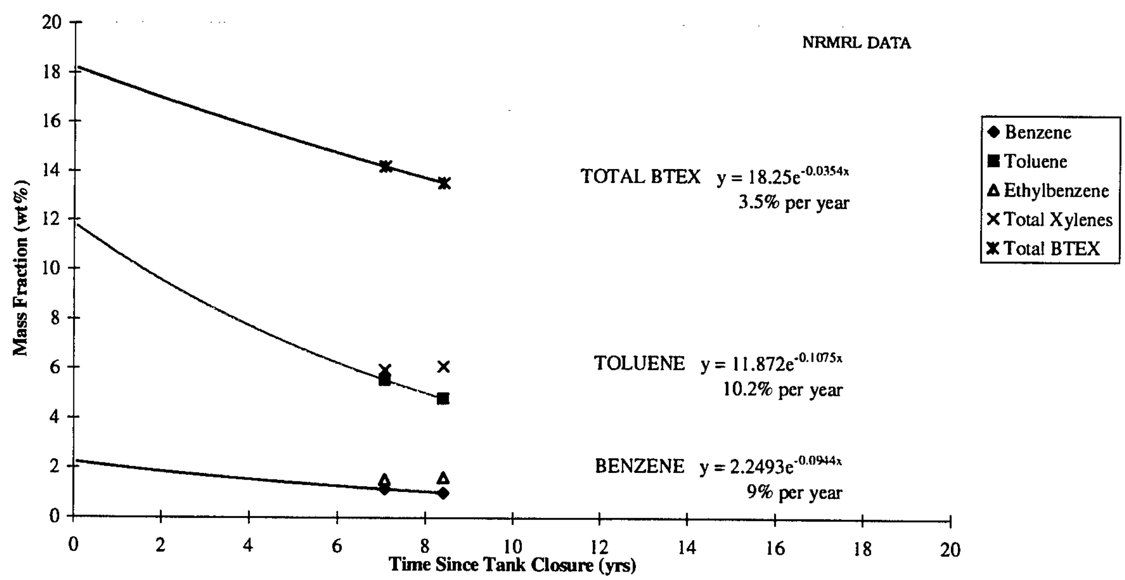


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TABLE 5.6
FUEL/WATER PARTITIONING COEFFICIENTS FOR FUEL RELEASE SITES
FUEL WEATHERING STUDY

Data Source/Site	Approximate Spill Age[a/]	Fuel/Water Partitioning Coefficients (K_{fw}) Benzene	Toluene	Ethyl-benzene	*o*-Xylene	*m*-Xylene	*p*-Xylene	Total Xylenes
Gasoline								
Cline et al., 1991	**Fresh Gasoline**	**350**	**1,250**	**4,500**	**3,630**	**4,350**	**4,350**	**NA[b/]**
Offutt AFB, NE (MW349-6, 1997)	8 years							
EAL ("Laboratory")[c/]		280	788	1,200	NA	NA	NA	1,267
NRMRL ("Field")[d/]		246	926	3,333	2,366	3,466	3,209	3,056
JP-4 Jet Fuel								
Smith et al., 1981	**Fresh JP-4**	**2,455**	**2,754**	**4,786**	**7,079**	**3,715**	**7,586**	**NA**
Shaw AFB, SC (MW1610-2, 1997)	3 years							
EAL ("Laboratory")		265	945	4,059	2,837	NA	NA	3,220
NRMRL ("Field")		266	554	1,138	971	1,041	1,093	1,024
Shaw AFB, SC (MW1610-2, 1998)	4 years							
EAL ("Laboratory")		217	789	3,415	2,583	NA	NA	2,903
NRMRL ("Field")		803	1,044	3,042	2,310	2,646	3,069	2,584
Myrtle Beach AFB, SC (MW-8I)	16 years							
EAL ("Laboratory")		203[e/]	1,508[e/]	3,553	13,909	NA	NA	3,634
NRMRL ("Field")		335	2,693	39,420	7,563	53,005	135,000	58,788
DFSP-Charleston, SC (MW-103)	22 years							
EAL ("Laboratory")		5[e/]	1,020[e/]	3,692	NA	NA	NA	3,600
NRMRL ("Field")		1	231	1,600	2,703	2,553	1,944	2,416
Eaker AFB, AR (MW-316)	24 years							
EAL ("Laboratory")		385	40,000	5,500	4,300	NA	NA	4,696
NRMRL ("Field")		104	9	4,205	9,486	5,405	5,080	5,689
JP-5 Jet Fuel								
Beaufort MCAS, SC Laboratory (EAL)	**Fresh JP-5 Sample**	**455**	**1,500**	**4,568**	**NA**	**NA**	**NA**	**4,815**
Beaufort Tank Farm C, SC (MW BFT-401-3)	7 years							
EAL ("Laboratory")		558[e/]	1,250	4,571	2,538	NA	NA	3,741
NRMRL ("Field")		341	345	761	1,283	925	1,246	1,116
Cecil Field NAS, FL (MW CEF-293-9)	16 years							
EAL ("Laboratory")		253[e/]	1,470[e/]	5,818	NA	NA	NA	6,636
NRMRL ("Field")		261	152	2,669	635	1,867	2,221	1,740
JP-8 Jet Fuel								
Seymour Johnson AFB, NC (MW-1S, 1997)	1.5 years							
EAL ("Laboratory")		240	1,005	3,127	NA	NA	NA	3,087
NRMRL ("Field")		229	251	1,390	1,860	1,891	1,729	1,850
Seymour Johnson AFB, NC (MW-1S, 1998)	2.3 years							
EAL ("Laboratory")		278	797	3,548	2,745	NA	NA	3,409
NRMRL ("Field")		59	220	1,448	1,459	1,165	1,361	1,289

[a/] Approximate age of spill as of the most recent sampling event.

[b/] NA = not available or not analyzed.

[c/] Results calculated from Evergreen Analytical Laboratory (EAL) partitioning experiment values for BTEX in mobile LNAPL and deionized water in contact with the mobile LNAPL.

[d/] Results calculated from mobile LNAPL and groundwater concentrations as determined by the National Risk Management Research Laboratory (NRMRL).

[e/] K_{fw} calculated using NRMRL mobile LNAPL analytical result because EAL result was less than the laboratory reporting limit.

Results of the fuel/water partitioning experiment do not refute use of equilibrium assumptions in estimating groundwater concentrations of BTEX compounds at gasoline and jet fuel release sites. However, the data presented in Table 5.6 suggest that using laboratory predictions of K_{fw} to estimate equilibrium concentrations in groundwater in the LNAPL source area may sometimes underestimate actual groundwater concentrations. For example, if the benzene concentration in mobile LNAPL at a JP-4 release site is known to be 1,250 mg/L, the Smith et al. (1981) K_{fw} value of 2,455 will indicate that the concentration in groundwater is approximately 0.51 mg/L (obtained by rearranging equation 2.2 to solve for C_w; C_w = 1,250 [mg/L] / 2,455 = 0.51 mg/L). However, K_{fw} results presented in Table 5.6 indicate that a benzene K_{fw} of 265 is more appropriate because the benzene concentration in source area groundwater is approximately 4.72 mg/L (K_{fw} = 1,250 [mg/L] / 4.72 [mg/L] = 265).

A consistent relationship between mobile LNAPL weathering and fuel/water partitioning was not observed. This is specifically demonstrated by the 1997 and 1998 K_{fw} values calculated for Shaw AFB and Seymour Johnson AFB, where field and laboratory values for K_{fw} do not vary consistently with increasing spill age. A more general review of the JP-4 sites taken as a whole, also indicates no apparent correlation between K_{fw} and spill age.

5.4 COMPARISON OF RESIDUAL AND MOBILE LNAPL WEATHERING

Weathering effects on residual-LNAPL-contaminated soils were compared to mobile LNAPL weathering in an attempt to demonstrate that LNAPL weathering is more significant in the capillary fringe soils than in the free-phase product. The primary weathering mechanisms thought to enhance weathering of residual LNAPL in soils are increased volatilization and biodegradation. Little to no BTEX depletion in mobile LNAPL is expected to occur from biodegradation, yet biodegradation is a significant weathering mechanism for residually contaminated soils (Section 2.3.3). Section 5.4.1 presents a simple quantitative evaluation of BTEX weathering in residual and mobile LNAPLs. Section 5.4.2 presents a qualitative comparison of hydrocarbon weathering in mobile and residual LNAPL through the use of soil and free product chromatograms from the DFSP-Charleston site.

5.4.1 BTEX Weathering

BTEX weathering in residual and mobile LNAPL was compared by converting soil analytical results reported on a mass per mass basis (i.e., mg/kg) to mass per volume units typical of mobile LNAPL results (μg/mL, mg/mL, or mg/L). The following relationship was used to estimate the concentration of BTEX compounds in residual LNAPL based on soil analytical results:

$$C_s = [\text{BTEX analyte (mg/kg) / TPH (mg/kg)}] \times \text{LNAPL density } (\mu\text{g/mL}) \qquad \text{eq. 5.9}$$

where: C_s = estimated residual LNAPL BTEX concentration (μg/mL)
TPH = total petroleum hydrocarbons in residual LNAPL

Note: TPH concentrations in soil were estimated by NRMRL analysis of total fuel carbon.

Table 5.7 presents the BTEX concentrations in residual LNAPL estimated using equation 5.9 and compares these estimates to the mobile LNAPL analytical results at the eight primary sites.

Based on the results presented on Table 5.7, attenuated BTEX concentrations in residual LNAPL as compared to mobile LNAPL analytical results were observed in the estimates for Offutt AFB and Shaw AFB. At Offutt AFB, estimated concentrations of toluene, ethylbenzene, and xylenes in capillary fringe soils were 5 to 23 percent less than their respective concentrations in mobile LNAPL. For the 1997 Shaw AFB soil data, BTEX concentrations were 1 to 34 percent less than the mobile LNAPL analytical results. Soil samples collected at Shaw AFB in 1998 indicate far less BTEX contamination in soils at 27 feet bgs as compared to the 1997 results at 33 feet bgs.

At DFSP-Charleston the estimated residual LNAPL concentrations of BTEX greatly exceed the mobile LNAPL results. As indicated on Figures 5.7 and 5.8, the total BTEX concentration in mobile LNAPL at EW-6 has been reduced by almost 99 percent. While BTEX concentrations are extremely low in mobile LNAPL at EW6, the total BTEX concentration of 230 mg/kg in soil at 13 feet bgs near EW-6 was the highest total BTEX concentration measured in soil at any of the JP-4 sites (Table 5.1). While significant BTEX depletion is evident in mobile LNAPL, significant BTEX contamination appears to remain in some soils near this location.

Overall, residual LNAPL concentrations of BTEX in soil estimated using equation 5.9 generally exceed actual mobile LNAPL concentrations for these compounds. Predicted residual LNAPL concentrations calculated from Myrtle Beach AFB, Eaker AFB, Cecil Field NAS, and Seymour Johnson AFB soil analytical results are approximately 1 to 3 times higher than the mobile LNAPL analytical results. Wiedemeier *et al.* (1995) observed that using the BTEX/TPH relationship illustrated by equation 5.9 to compare residual and mobile LNAPL concentrations also indicated residual BTEX concentration overestimates especially within the LNAPL source area. In theory, the residual BTEX concentrations should never exceed the mobile LNAPL BTEX concentrations. A significant source of error in equation 5.9 is the TPH term. TPH analysis is prone to underestimation of the total fuel residual in the soil. Underestimation of TPH would lead to the false conclusion that the BTEX fraction in soil residuals exceeds the BTEX fraction in mobile LNAPL.

5.4.2 Comparison of Soil and Free Product Chromatograms

A qualitative comparison of residual LNAPL and mobile LNAPL weathering is possible by evaluating chromatograms of soil and free product samples. Figure 5.16 presents GC/FID results for mobile LNAPL samples collected from two wells (MW-103 and EW-6) at the DFSP-Charleston site. Soil sample GC/FID results for one soil boring (CHSB3) advanced in the original source area at the DFSP-Charleston site are presented in Figure 5.17. Results presented in these two figures are from samples collected in May 1997 and analyzed by AD Little (1998). During this sampling event, the water table surface was measured approximately 15 to 16 feet bgs.

Chromatograms for soil samples indicate that single-ring aromatic hydrocarbon concentrations in residual LNAPL increase with depth and likely approach

TABLE 5.7
COMPARISON OF ESTIMATED RESIDUAL AND MOBILE LNAPL BTEX CONCENTRATIONS
FUEL WEATHERING STUDY

Fuel Type Site	Sample Date	Free Product Sample Location	Approximate Spill Age[a/]	Depth to Product (feet btoc)[b/]	Depth of Soil Sample (feet bgs)[c/]	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Total BTEX
Gasoline										
Offutt AFB, NE	Nov-94	MW349-1	4	39.60	39.5					
Estimated Residual LNAPL [d/] (µg/mL)[e/]						16,034	39,335	9,141	32,217	96,727
Mobile LNAPL [f/] (µg/mL)						8,280	41,100	10,300	42,080	101,760
Estimated Residual / Mobile						1.94	0.96	0.89	0.77	0.95
JP-4 Jet Fuel										
Shaw AFB, SC	Mar-97	MW1610-2	3	32.38	33.0					
Estimated Residual LNAPL (µg/mL)						2,225	3,220	916	6,619	12,980
Mobile LNAPL (µg/mL)						2,250	4,890	1,340	8,530	17,010
Estimated Residual / Mobile						0.99	0.66	0.68	0.78	0.76
Shaw AFB, SC	Mar-98	MW1610-2	4	28.24	27.0					
Estimated Residual LNAPL (µg/mL)						101	168	561	2,687	3,517
Mobile LNAPL (µg/mL)						1,250	2,830	1,040	7,180	12,300
Estimated Residual / Mobile						0.08	0.06	0.54	0.37	0.29
Myrtle Beach AFB, SC	Mar-97	MW8I	16	3.7	9.5					
Estimated Residual LNAPL (µg/mL)						1,536	8.4	3,324	9,666	14,535
Mobile LNAPL (µg/mL)						211	7.5	1,360	4,262	5,841
Estimated Residual / Mobile						7.28	1.12	2.44	2.27	2.49
DFSP-Charleston (Tank 1), SC	May-97	EW-6	22	15.92	13.0					
Estimated Residual LNAPL (µg/mL)						85	1,764	2,789	14,082	18,721
Mobile LNAPL (µg/mL)						0.025	1.35	91.3	351	444
Estimated Residual / Mobile						3415	1307	31	40	42
Eaker AFB, AR	Aug-97	MW316	24	13.86	12.0	2,658	10	4,086	20,011	26,764
Estimated Residual LNAPL (µg/mL)						900	0.025	2,960	15,400	19,260
Mobile LNAPL (µg/mL)						2.95	384	1.38	1.30	1.39
Estimated Residual / Mobile										

TABLE 5.7 (Continued)

COMPARISON OF ESTIMATED RESIDUAL AND MOBILE LNAPL BTEX CONCENTRATIONS

FUEL WEATHERING STUDY

Fuel Type Site	Sample Date	Free Product Sample Location	Approximate Spill Age[a/]	Depth to Product (feet btoc)[b/]	Depth of Soil Sample (feet bgs)[c/]	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Total BTEX
JP-5 Jet Fuel										
Beaufort Tank Farm C, SC	May-97	BFT-401-3	7	6.98	4.0					
Estimated Residual LNAPL (µg/mL)						7.6	93	557	1,820	2,477
Mobile LNAPL (µg/mL)						2.2	13	116	611	742
Estimated Residual / Mobile						3.41	7.16	4.80	2.98	3.34
Cecil Field NAS, FL	May-97	CEF-293-9	16	8.54	8.5					
Estimated Residual LNAPL (µg/mL)						27	479	3,925	10,574	15,004
Mobile LNAPL (µg/mL)						24	122	2,520	4,787	7,453
Estimated Residual / Mobile						1.13	3.92	1.56	2.21	2.01
JP-8 Jet Fuel										
Seymour Johnson AFB, NC	May-97	MW1S	2	5.08	5.5					
Estimated Residual LNAPL (µg/mL)						386	2,311	2,004	10,441	15,142
Mobile LNAPL (µg/mL)						194	1,030	1,170	5,990	8,384
Estimated Residual / Mobile						1.99	2.24	1.71	1.74	1.81
Seymour Johnson AFB, NC	Mar-98	MW1S	3	3.11	3.0					
Estimated Residual LNAPL (µg/mL)						181	1,020	1,440	6,016	8,658
Mobile LNAPL (µg/mL)						47	602	800	3,040	4,489
Estimated Residual / Mobile						3.84	1.69	1.80	1.98	1.93

a/ Approximate age of spill at time of sampling event.

b/ feet btoc = feet below top of well casing.

c/ feet bgs = feet below ground surface.

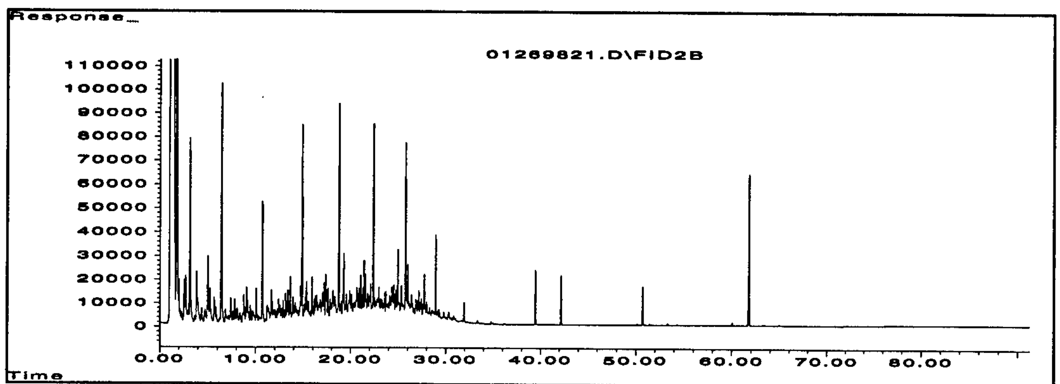
d/ Estimated mass per volume concentration in residual LNAPL calculated using equation 5.9 and NRMRL soil sample results.

e/ µg/mL = micrograms per milliter.

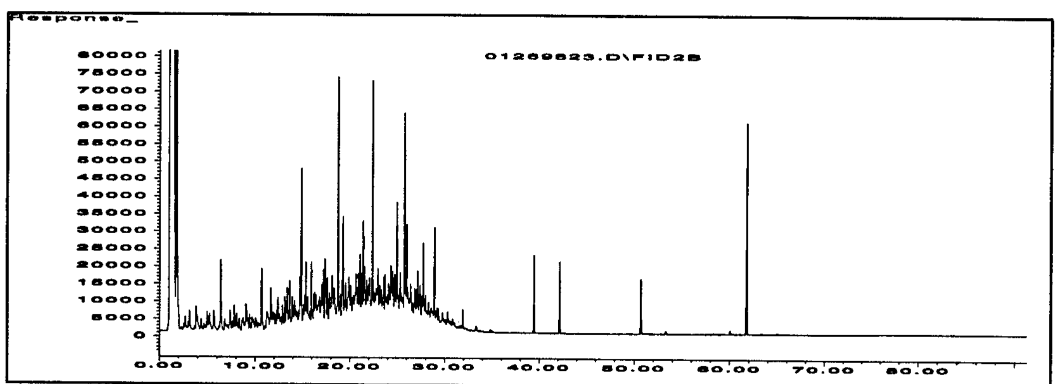
f/ Mobile LNAPL concentration as determined by NRMRL.

022/729691/39.xls, T5.7

FIGURE 5.16
CHROMATOGRAMS FOR TWO JP-4 MOBILE LNAPL SAMPLES
DFSP-CHARLESTON, SOUTH CAROLINA
FUEL WEATHERING STUDY



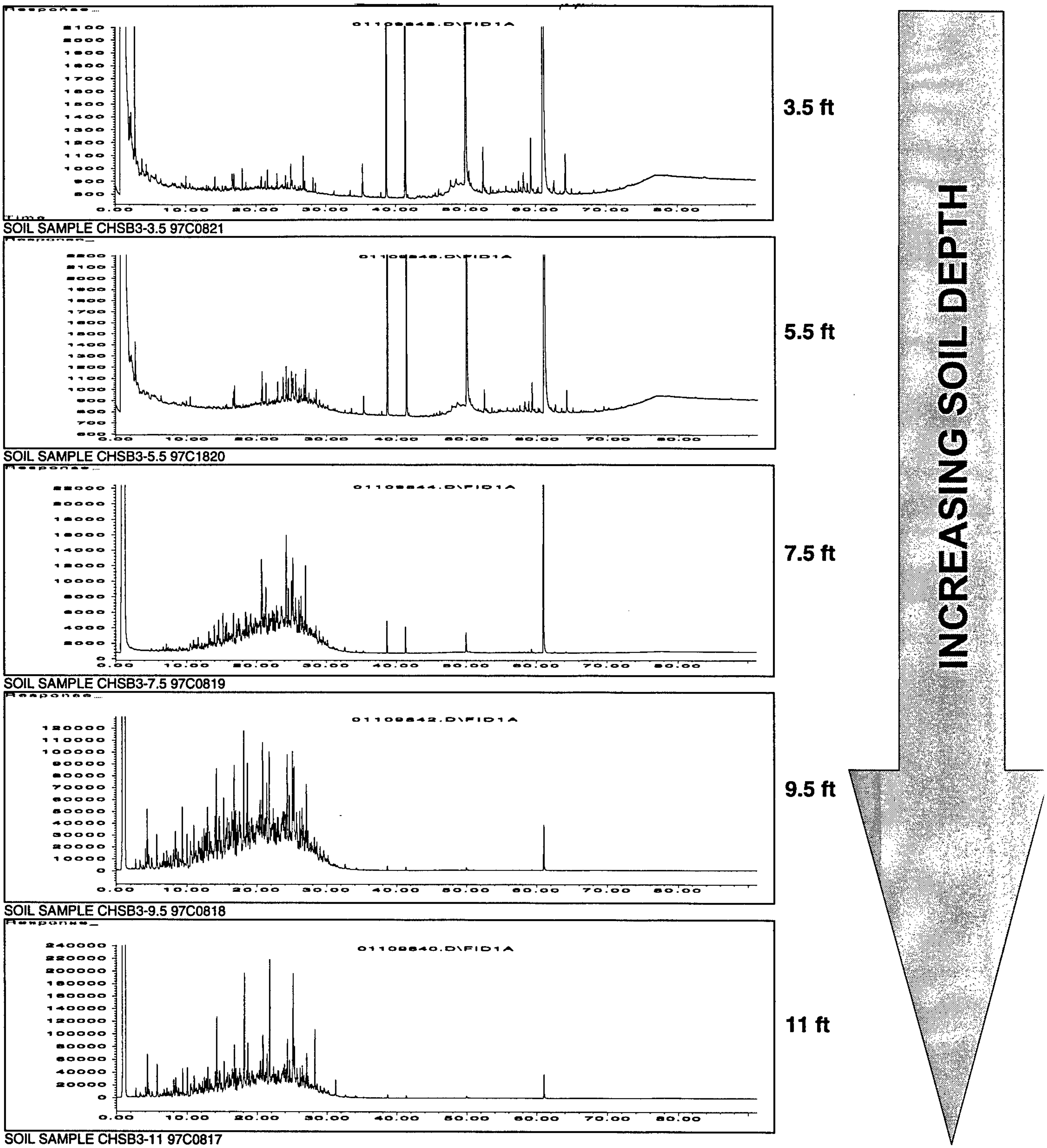
FREE PRODUCT SAMPLE CH-W103-FP 97C0813



FREE PRODUCT SAMPLE CH-EW6-FP 97C0814

Source: AD Little (1998).

FIGURE 5.17
JP-4 IMPACTED SOIL CHROMATOGRAM RESULTS WITH DEPTH
DFSP-CHARLESTON, SOUTH CAROLINA
FUEL WEATHERING STUDY



Source: AD Little (1998).

concentration levels consistent with mobile LNAPL near the water table. As shown in Figure 5.17, little residual LNAPL BTEX compounds remain in soils at the 3.5- and 5.5-foot depths. The sample collected from 7.5 feet bgs indicates that fuel hydrocarbons are still present in these soils, but the BTEX compounds which are removed during the first 10 minutes of chromatographic separation are completely depleted. Soil samples collected 9.5 and 11.5 feet bgs appear to retain the general signature of the JP-4 mobile LNAPL samples (Figure 5.16). BTEX weathering appears to be less significant in these deeper soils than observed in mobile LNAPL from EW-6, but more significant than that observed in free product from MW-103. As discussed in Sections 2.5.1 and 5.2.3.5.2, mobile LNAPL weathering appears to vary spatially at fuel contaminated sites. Residual LNAPL weathering rates most likely vary with proximity to saturated LNAPL lenses and mobile LNAPL pools.

In theory, more porous soils and sites without impermeable covers should promote greater residual LNAPL volatilization and biodegradation. Sites which are not subject to large and frequent water level variations should also produce a more weathered residual LNAPL because these soils would not be regularly "recontaminated" with mobile LNAPL. Based on our study, it is impossible to predict residual LNAPL weathering from the limited soil sampling performed at each site. Several samples of residual fuel contamination are needed to estimate the remaining BTEX fraction in soils at each depth interval.

SECTION 6

CONCLUSIONS

6.1 REVIEW OF PROJECT OBJECTIVES

The overall purpose of this study was to improve the scientific database for estimating natural LNAPL weathering rates and source-term reduction rates which are incorporated into natural attenuation models. Based on our literature review, little information has been published regarding rates of natural weathering of the BTEX compounds from mobile fuel LNAPLs. As a result, the rate of reduction of the contaminant source term in groundwater models is often left to professional judgment. This has generally resulted in the use of overly conservative LNAPL weathering rates to evaluate contaminant fate and transport and the suitability of natural attenuation as a remedial alternative. These conservative assumptions extend the estimated timeframe for achieving cleanup goals and inflate projected long-term monitoring and site management costs.

The primary objective of this fuel weathering study was to document a range of BTEX weathering rates for the mobile LNAPL fraction based on data collected from sites with documented mobile LNAPL plumes with known release dates. Secondary objectives of this study included an evaluation of the degree of contaminant partitioning of BTEX from mobile LNAPL to groundwater, and comparison of weathering effects on the mobile LNAPL fraction and on residual LNAPL present in capillary fringe soils. The following tasks were completed to meet these objectives:

- A literature search to assess existing information regarding weathering of LNAPLs;
- Selection of eight primary sites where the time of release is generally known and free-phase jet fuel or gasoline remain *in situ*;
- Sampling of soil, groundwater, and free-phase LNAPLs at the primary sites;
- Evaluation of data obtained from the eight primary sites, as well as data from four secondary sites, to assess contaminant concentrations in site media in relation to such factors as age of the fuel release, fuel type, and site geology and hydrogeology.

6.2 SUMMARY OF FINDINGS

- Significant research has been completed on multiple "fresh" samples of JP-4 and JP-8 so that the magnitude of the initial BTEX fraction in these fuels is well-

known. The assumption that initial BTEX values in mobile LNAPL at JP-4 and JP-8 release sites are equal to concentrations reported by Smith *et al.* (1981) and Mayfield (1996) appears reasonably valid for predicting BTEX depletion in mobile LNAPL. Initial fuel composition results for gasoline studies are more varied and results for JP-5 are very limited.

- Free-phase fuel BTEX weathering rates will vary from site to site and are influenced by many factors including spill age, the relative solubility of individual compounds, free product geometry, and the rate at which groundwater and precipitation contacts LNAPL.

- As demonstrated by the DFSP-Charleston and Offutt AFB site data, the BTEX fraction remaining in free-phase LNAPL samples collected from different locations on the same site will vary. It is likely that samples collected near the center of the LNAPL volume will exhibit lower rates of weathering than samples collected at the leading edge of the LNAPL "plume." A more accurate estimate of LNAPL weathering can be obtained by collecting multiple samples from the area impacted by mobile LNAPL and averaging the remaining BTEX fraction.

- Based on Raoult's Law, weathering of BTEX from LNAPL via dissolution and volatilization is expected to follow first-order kinetics which predicts that the rate of BTEX removal from the free-phase will be reduced as the concentrations of BTEX in the free-phase decrease over time. While this phenomenon is difficult to prove with only one or two historical data points per site, the first-order weathering rate appears to be validated when average remaining BTEX fractions from five JP-4 sites were plotted together. Based on our data, weathering rates decreased as the age of the spill increased.

- Based on Figure 5.3, the average total BTEX, first-order weathering rate for five JP-4 sites is approximately 16 %/yr. Based on all of the data collected, this appears to be a reasonable default value for estimating total BTEX weathering from JP-4 LNAPL.

- If mathematically inflated rates from McChord AFB data, and questionably low weathering rates from Eaker AFB are excluded, the range of total BTEX, first order weather rates is 11 to 23 %/yr. If a more conservative first-order weathering rate is desired for BTEX fate and transport modeling, 11 %/yr would provide a conservative estimate for JP-4 fuels.

- As predicted by their relatively high solubilities, benzene and toluene exhibit higher weathering rates than ethylbenzene and xylenes. Because benzene is a known human carcinogen with a federal MCL of 5 μg/L, benzene weathering rates will generally determine the timeframe for fuel spill remediation. Based on Figure 5.4, the average benzene first-order weathering rate for five JP-4 sites is approximately 26 %/yr. Based on all of the data collected, this appears to be a reasonable default value for estimating benzene weathering from JP-4 LNAPL. If mathematically inflated rates from McChord AFB data, and questionably low weathering rates from Eaker AFB are excluded, the range of benzene first-order weather rates is 19 to 35 %/yr. If a more conservative first-order weathering rate is desired for benzene fate and transport modeling, 19 %/yr would provide a

conservative estimate for JP-4 fuels. Benzene and total BTEX first-order weathering rates for JP-4 and JP-8 are shown in Table 6.1.

- Dissolution appears to be the primary weathering mechanism that influences mobile LNAPL weathering rates. Significantly lower BTEX weathering rates in mobile LNAPL were apparent at sites with low groundwater velocities. This observation is supported by mass transfer theory which predicts that BTEX flux from LNAPL to groundwater would increase in a rapidly moving groundwater where dissolved BTEX concentrations would be diluted by the constant influx of clean water.

- Although initial BTEX fractions in JP-8 are lower than JP-4, the first-order weathering rate for the Seymour Johnson JP-8 site was 25 %/yr for total BTEX and 29 %/yr for benzene (Table 6.1). The first-order weathering rates calculated for JP-4 should provide a reasonable estimate for JP-8.

- Determination of BTEX weathering rates for JP-5 mobile LNAPLs is difficult due to the low initial concentrations of BTEX. There is very little BTEX in JP-5 and groundwater at JP-5 release sites will not be significantly impacted by BTEX compounds.

- The large range of potential initial BTEX values for gasoline combined with sample result disparities and site-specific limitations of the Offutt AFB site, prevented meaningful determination of mobile LNAPL weathering rates for BTEX in gasoline.

- Although a consistent correlation between mobile LNAPL and residual LNAPL weathering at each site was not observed, the relative contributions of volatilization and biodegradation should increase in contaminated soils above the mobile LNAPL layer. This increase in residual weathering would be most apparent at sites without impermeable surfaces and sites with more porous soils where volatilization and atmospheric oxygen diffusion are more likely to occur. At fuel contaminated sites, several samples are needed at varying depths to accurately estimate the residual BTEX contamination in soil.

TABLE 6.1
SUMMARY OF BENZENE AND TOTAL BTEX FIRST-ORDER WEATHERING RATES IN JP-4 AND JP-8 MOBILE LNAPL
FUEL WEATHERING STUDY

	Benzene (% Reduction/Year [a/])	Total BTEX (% Reduction/Year)
JP-4 MOBILE LNAPL		
Average of 5 Sites	26	16
Range Excluding Outliers[b/]	19 to 35	11 to 23
Conservative Estimate	19	11
JP-8 MOBILE LNAPL[c/]		
Average	29	25
Range	6 to 53	14 to 36

a/ Weight percent reduction per year calculated using equation 5.8.

b/ Excludes data from the McChord AFB and Eaker AFB sites.

c/ Summary of eight samples collected over 2 years from the Seymour Johnson AFB site.

SECTION 7

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APPENDIX A

WORK PLAN AND SITE ADDENDA FOR THE FUEL WEATHERING STUDY

A-1

WORK PLAN

DRAFT

Work Plan for Determining LNAPL Weathering at Various Fuel Release Sites

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas

October 1996

PARSONS
ENGINEERING SCIENCE, INC.

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DRAFT

WORK PLAN FOR DETERMINING LNAPL WEATHERING AT VARIOUS FUEL RELEASE SITES

October 1996

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

TECHNOLOGY TRANSFER DIVISION

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ACRONYMS AND ABBREVIATIONS

ABB	ABB Environmental Services, Inc.
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AST	above ground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
°C	degrees centigrade
CA	contamination assessment
CAP	corrective action plan
CAR	contamination assessment report
DFSC	Defense Fuel Supply Center
DFSP	Defense Fuel Supply Point
DOD	Department of Defense
ECT	Environmental Consulting and Technology, Inc.
ES	Engineering-Science, Inc.
FDEP	Florida Department of Environmental Protection
HDPE	high density polyethylene
ID	inside diameter
IDW	investigation-derived waste
IT	IT Corporation
IWTP	industrial wastewater treatment plant
LCS	laboratory control sample
LMB	laboratory method blank
LNAPL	light non-aqueous phase liquid
mg/L	milligrams per liter
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MW	monitoring well
NAPL	nonaqueous-phase liquid
NAS	Naval Air Station
NPDES	National Pollution Discharge Elimination System
NRMRL	National Risk Management Research Laboratory
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
OD	outside diameter
OVM	organic vapor meter
Parsons ES	Parsons Engineering Science, Inc.
PID	photoionization detector
ppmv	parts per million volume per volume

PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAP	remedial action plan
RNA	remediation by natural attenuation
Rust	Rust Environment & Infrastructure
RW	recovery well
SAR	site assessment report
SCDHEC	South Carolina Department of Health and Environmental Control
SVE	soil vapor extraction
TPH	total petroleum hydrocarbons
USAEHA	United States Army Environmental Hygiene Agency
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound
WEGS	Westinghouse Environmental & Geotechnical Services

SECTION 1

INTRODUCTION

This work plan, prepared by Parsons Engineering Science, Inc. (Parsons ES), presents the scope of work required for the collection of data necessary to evaluate natural weathering rates of mobile and residual light nonaqueous-phase liquids (LNAPLs) resulting from petroleum releases to the subsurface environment. As part of the natural attenuation demonstration project (Contract No. F41624-92-D-8036, Delivery Order 25), the Air Force Center for Environmental Excellence (AFCEE) has contracted with Parsons ES to perform this fuel weathering study. Of particular interest for the study is the weathering of fuels such as JP-4 jet fuel, JP-8 jet fuel, and gasoline each of which contain relatively high mass fractions of benzene, toluene, ethylbenzene, and total xylenes (BTEX).

1.1 PROJECT SCOPE AND OBJECTIVES

At many government and general industry sites, large-volume environmental releases of jet fuel or gasoline have contaminated and continue to contaminate soil and groundwater systems. Primary sources of large-volume fuel releases include fuel handling and storage activities associated with aboveground storage tanks (ASTs), underground storage tanks (USTs), fuel pumphouses, fuel hydrant systems, oil/water separators, and fuel pipelines, to name a few. Uncontrolled catastrophic or chronic releases from one of these primary sources can result in large volumes of fuel being released to the subsurface. When released, fuels such as JP-4 and gasoline represent oily-phase liquids, which are less dense than water. In the subsurface, the LNAPL is often present as both a mobile and a residual contaminant source. Residual LNAPL is defined as the LNAPL that is trapped in the aquifer by the processes of cohesion and capillarity, and therefore, will not flow within the aquifer or from the aquifer matrix into a well under the influence of gravity. Mobile LNAPL is defined as LNAPL that is free to flow in the aquifer and will flow from the aquifer matrix into a well under the influence of gravity.

Little information is currently available regarding rates of natural weathering or attenuation of mobile and residual LNAPLs. As a result, conservative BTEX reduction rates for LNAPLs typically are used when predicting the persistence and concentration of fuel hydrocarbon sources. The use of overly conservative LNAPL weathering rates at sites selected for remediation by natural attenuation (RNA) can extend the estimated timeframe for long-term monitoring and affect the estimated cost effectiveness and administrative feasibility of implementing RNA. The purpose of this study is to

improve the scientific basis and defensibility for determining LNAPL weathering rates, (i.e., source reduction rates) as a component of the RNA alternative.

As used in this report, RNA refers to a management strategy that relies on natural attenuation mechanisms to remediate soil and groundwater contaminants and to reduce and control risks associated with contaminants in the subsurface. The United States Environmental Protection Agency (USEPA) Offices of Research and Development (ORD) and Solid Waste and Emergency Response (OSWER) define natural attenuation as:

The biodegradation, dispersion, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the ecosystem.

The primary objective of this study is to determine an average range of natural weathering rates for the mobile LNAPL fraction based on literature values and data collected from sites with documented mobile LNAPL plumes that have resulted from past jet fuel or gasoline releases. Three secondary objectives are 1) to review the available literature as it pertains to natural weathering of fuel LNAPLs in the subsurface environment; 2) to compare weathering effects on the mobile LNAPL fraction and on residual LNAPL present in capillary fringe soils; and 3) to evaluate the degree of contaminant partitioning occurring from mobile LNAPL to the groundwater. Accomplishment of these objectives will involve conducting the following tasks:

- A literature search to assess existing information regarding weathering of LNAPLs;
- Selection of 10 sites where releases of gasoline or jet fuel have occurred and free-phase LNAPLs remain *in situ*;
- Sampling of soil, groundwater, and free-phase LNAPLs at the selected sites; and
- Various trend analyses of current contaminant concentrations in site media and their relation to age of the fuel release, fuel type, and site geology and hydrogeology.

The field work for this project primarily will involve collection of soil, groundwater, and free product samples from the selected sites. It is anticipated that two soil samples from the capillary fringe, four free product samples, and two groundwater samples will be collected from each site and submitted for laboratory analysis of BTEX concentrations in each media type. Soil samples also will be analyzed for total petroleum hydrocarbons (TPH) and soil moisture in order to compare weathering effects in soils and in free-phase LNAPLs. It is anticipated that the majority of sites will be sampled using a Geoprobe®, which is "a hydraulically-powered, percussion/probing machine" specifically designed for environmental sampling of shallow unconsolidated media and groundwater. It is anticipated that field work at each of the selected sites will last approximately 0.5 to 2 days. All field work will follow the health and safety procedures presented in the program *Health and Safety*

Plan for Bioplume II Modeling Initiative (Engineering-Science, Inc. [ES], 1993), and site-specific addenda developed for each site.

Following field sampling and receipt of sample results, data from each of the sites will be analyzed for the target parameters described in Section 3, and a technical report will be prepared by Parsons ES and submitted to AFCEE. The technical report will summarize the findings of the literature review and will provide an assessment of site-specific LNAPL weathering rates considering the age of the LNAPL and the original fuel type. In addition, the report will examine variations in LNAPL weathering effects in soil and groundwater within the contaminant source areas.

1.2 WORK PLAN ORGANIZATION

This work plan consists of six sections, including this introduction, and one appendix. Section 2 presents site selection criteria, a listing of candidate sites selected for the study, background information for each of the sites, and proposed site sampling locations. Section 3 describes procedures for collection and analysis of site data. Section 4 discusses the quality assurance/quality control (QA/QC) measures to be used during this project. Section 5 describes the data analyses to be performed for determining LNAPL weathering and its effects on soil and groundwater. Section 6 contains the references used in preparing this document. Appendix A provides a draft listing of references to be reviewed during the literature search.

1.3 PRELIMINARY LITERATURE REVIEW

The purpose of the proposed literature review is to compile and summarize the technical literature on natural weathering of fuel LNAPLs in the subsurface environment. Specifically, the literature search will attempt to answer the following question:

> Is there sufficient scientific information available regarding *in situ* LNAPL weathering rates to refine modeling assumptions commonly used to predict reductions in the contaminant source term in RNA demonstrations at fuel-hydrocarbon-contaminated sites?

While a complete summary of the available literature will be provided with the final technical report submitted to AFCEE upon project completion, a preliminary review of the literature suggests that little information currently exists regarding LNAPL weathering rates in the subsurface or fuels weathering in general. The majority of information currently available regarding subsurface fuel contamination examines the effects of specific natural attenuation mechanisms such as dissolution, biodegradation, and volatilization as they apply to soil and groundwater contamination. While the literature has focused on these mechanisms as they apply to attenuation of chemicals sorbed to soil and dissolved in groundwater, mobile LNAPL weathering also is a function of these processes. Based on this preliminary review of the literature, the proposed quantitative assessment of LNAPL weathering will provide valuable data on the behavior of fuels over time at release sites.

A brief summary of the literature as it pertains to these mechanisms is provided below. A brief description of methods to assess fuel weathering, and oil mass loss rates from a spill in Bemidji, Minnesota are also presented.

1.3.1 LNAPL and Weathering

Weathering of petroleum hydrocarbons in the subsurface environment has historically been interpreted as the observed change in petroleum product composition with time due mostly to preferential volatilization of constituents with the greatest vapor pressures (Worthington and Perez, 1993). The term weathering as it is used for this study refers to the combined effects of natural destructive and non-destructive processes to reduce a fuel contaminant's persistence, mobility, mass, and toxicity in the environment. The primary mechanisms acting to reduce the strength of a mobile LNAPL source are dissolution, biodegradation, and volatilization. These mechanisms are influenced by physical and chemical properties of the chemical compounds in the source product, as well as by physical, chemical, and biological properties of the soil and groundwater system.

1.3.1.1 Dissolution

Dissolution is the dissolving of chemical substances from a nonaqueous-phase liquid (NAPL) into percolating precipitation water and/or the groundwater. Various bench-scale studies have been performed that examine the effects of dissolution on residual LNAPLs in soils (Borden and Kao, 1992; Rixey *et al.*, 1992; Voudrias *et al.*, 1994). In the latter two studies, water was flushed through soil columns to assess dissolution rates as they applied to aromatic compounds typical of petroleum hydrocarbon contamination (i.e., benzene, toluene, and xylenes). In addition, the Voudrias *et al.* (1994) study compared soil column and sand column effluent BTEX concentrations resulting from dissolution of a residual JP-4 jet fuel LNAPL. In both studies, flushing of soils with residual LNAPL resulted in either increasing or stable dissolved effluent BTEX concentrations during the initial stages of dissolution. Decreases in effluent concentration with continued flushing occurred only after the residual LNAPL became sorbed to the soil within the column. Following this transition, dissolved contaminant concentrations decreased rapidly and then leveled off. Increasingly greater pore volumes of water were required for each subsequent percent decrease in dissolved contaminants. In the Voudrias *et al.* (1994) study which involved dissolution of JP-4 in a soil column, benzene was reduced to 50 percent of its maximum effluent concentration after flushing with 720 pore volumes, and toluene was reduced to 50 percent of its maximum effluent concentration after 1,860 pore volumes. Ethylbenzene and xylene were not reduced to below 50 percent of their maximum effluent concentration even after flushing with 3,810 pore volumes. These studies suggest that an unrealistic number of pore volumes of groundwater must be flushed through the contaminated area to achieve complete dissolution of the aromatic compounds typical of gasoline and jet fuels.

The impacts of contaminant solubility and molecular size on dissolution rates also has been studied. Benzene and toluene, which have higher solubilities than the other

two BTEX compounds, possessed the greatest dissolution rates and were removed first, followed by ethylbenzene and xylenes, in the jet fuel dissolution experiments (Voudrias *et al.*, 1994). Decreased contaminant solubility results in a decreased dissolution flux and prolongs remediation by flushing (Yang *et al.*, 1995).

Significant debate appears in the literature regarding the applicability of equilibrium conditions when assessing dissolution (Hayden *et al.*, 1992; Seagren *et al.*, 1993; Voudrias *et al.*, 1994; and Yang *et al.*, 1995). Under equilibrium conditions, it is assumed that if the concentration of the contaminant in one phase is known, the contaminant concentration in other phase(s) can be determined (Powers *et al*, 1991). The existence of equilibrium conditions between an LNAPL and groundwater would allow for determination of LNAPL contaminant mole fractions based on concentrations of the contaminant in groundwater. Based on this theory, contaminant depletion in LNAPL could be tracked through monitoring of groundwater contaminant depletion. However, the equilibrium assumption as it applies to LNAPLs and groundwater contaminant concentrations has yet to be adequately demonstrated (Powers *et al.*, 1991). Yang *et al.* (1995) argue that the rate of dissolution is a significant rate-limiting factor in the remediation of soils contaminated with NAPLs. Dissolution also may be rate-limiting for LNAPL weathering.

1.3.1.2 Biodegradation

Biodegradation represents another significant mechanism for petroleum contaminant weathering in the subsurface. Most of the literature pertaining to *in situ* biodegradation refers to the adsorbed, or residual, and dissolved phases. As mentioned in the preceding section, dissolution appears to be a rate-limiting factor in weathering, especially as it relates to biodegradation. Biodegradation of dissolved petroleum contaminants reduces aqueous contaminant concentrations and thereby enhances dissolution rates by increasing mass transfer of soluble compounds from mobile and residual LNAPLs into groundwater (Seagren *et al.*, 1993; Yang *et al.*, 1995). As a result of this diffusion limitation, mass loss rates of dissolved contaminants from biodegradation initially appear to be between zero and first order (Song *et al.*, 1990), and decrease with time (Barker *et al.*, 1987).

The kinetics of biodegradation are complicated by the fact that biodegradation is compound specific and is significantly affected by the geochemistry of the subsurface environment. Dean-Ross (1993) examined the fate of JP-4 jet fuel in subsurface soils and discovered that for the less volatile, higher-molecular-weight jet fuel components, biodegradation represented a significant mechanism for reducing soil contamination. Song *et al.* (1990) concluded that saturated compounds such as hexane are generally more easily biodegraded than the corresponding aromatic compounds. In a study by Barker *et al.* (1987), mass loss rates for aromatics in groundwater due to biodegradation were greatest for xylenes, followed by toluene, and benzene. Other factors playing an important role in contaminant biodegradation include availability of nutrients, availability of oxygen, and the interfacial area available for mass transfer to aqueous or gaseous phases (Yang *et al.*, 1995). Looking at residual LNAPLs, the size of the LNAPL globules impacts biodegradation rates, with smaller globules resulting in

greater interfacial area for mass transfer, and greater biodegradation rates (Yang *et al.*, 1995). Mobile LNAPLs present as free product floating on the groundwater would have a low interfacial area (lower bioavailability) in comparison to the residual LNAPL globules in the unsaturated zone. Finally, it has been noted that biodegradation rates decrease with increasing contaminant concentrations (Schwille, 1967; Stroo *et al.*, 1992). From this information it can be inferred that mobile LNAPL may be subject to little biodegradation, as it represents the most concentrated contaminant phase.

1.3.1.3 Volatilization

Volatilization is expected to be a significant weathering mechanism for petroleum products such as gasoline, JP-4, and JP-8. From a study on the fate of JP-8 in quiescent flask systems containing water and water/sediment mixtures, evaporation or volatilization from water was the major removal mechanism for low-molecular-weight, volatile hydrocarbons (Dean-Ross *et al.*, 1992). In the same study it was determined that the presence of sediment can sequester jet fuel and render it less susceptible to volatilization. Intuitively, greater contact between soil gas and residual LNAPL would result in greater mass loss rates due to volatilization than soils saturated with mobile LNAPL.

1.3.2 Methods for Assessing Weathering

While little information on actual LNAPL weathering rates, or source reduction rates has yet to be identified, various methods to qualitatively or quantitatively assess contaminant weathering have been proposed. Luhrs and Pyott (1992) presented a paper on the use of trilinear plots to graphically represent plume zonation, contaminant source identification, and contaminant weathering in groundwater for gasoline releases. This methodology relies upon plotting relative ratios of source contaminants, such as the BTEX compounds, on a trilinear plot. Due to differences in vapor pressures and susceptibility to biodegradation, BTEX contaminants in groundwater will attenuate at different rates. For example, the ratio of benzene to total xylenes in groundwater is higher for a recent gasoline release than for an older release that has weathered. While this method appears to give more of a qualitative assessment of the degree of contaminant weathering in groundwater, trilinear plots can facilitate the interpretation of data that have been collected over time.

Petroleum chemical indicators, or biomarkers, recently have been evaluated as a method to assess the degree of total oil depletion occurring as a result of crude oil weathering (Douglas *et al.*, 1994). Based on the methodology presented, if concentration data from the source oil is available on a mass fraction basis, the increase in the mass fraction of a conservative chemical indicator in a weathered product relative to its initial mass fraction in the source oil is proportional to the amount of oil lost via weathering. For crude oil, Douglas *et al.* consider hopane as the conservative internal indicator, whereas for mid-range refined petroleum products such as diesel fuel and fuel oil #2, phenanthrenes/anthracenes can be used to assess total oil losses due to weathering. Internal biomarkers for lighter aromatic fuels such as gasoline and JP-4 jet fuel were not suggested. Trimethylbenzene and tetramethylbenzene isomers have been

suggested as reliable conservative tracers in anaerobic soil and groundwater systems (Wiedemeier, 1995).

1.3.3 Example Crude Oil Weathering Rate at Bemidji Spill Site

In 1979, a crude oil pipeline near Bemidji, Minnesota burst and released approximately 450,000 gallons of crude oil into a glacial outwash aquifer. In 1982, the site was selected for a long-term interdisciplinary study by the US Geological Survey. Oil-mass loss rates at the site have been studied to assess the degree of weathering resulting primarily from volatilization and dissolution. Based on one of these studies, annual oil-mass loss rates determined at different site locations ranged from 0 to 1.25 percent (Landon and Hult, 1991). Total cumulative oil losses after approximately 10 years of weathering were reported to be as much as 11 percent. Weathering rates for lighter refined petroleum products are expected to be greater than those calculated for the Bemidji site due to increased volatility, solubility, and biodegradability of the source contaminants.

SECTION 2

SELECTION OF STUDY SITES

The primary objective of this study is to determine an average range of natural *in situ* weathering rates for LNAPL associated with JP-4 or JP-8 jet fuel or gasoline spills based on existing literature and data collected from sites with mobile LNAPL contamination. Based on the apparent lack of existing LNAPL weathering rate literature, candidate study site identification, selection, and field sampling is necessary to gather data to evaluate weathering rates. The site selection criteria for this fuel weathering study are presented in Section 2.1. Primary and secondary candidate sites identified to date are reviewed in Sections 2.2 and 2.3, respectively. If additional primary sites are identified during the course of this study, they will be considered for sampling with the concurrence of AFCEE/ERT.

2.1 SITE SELECTION CRITERIA

To evaluate a site's potential as a candidate for this fuel weathering study, the following selection criteria were developed by Parsons ES:

1. Presence of recoverable mobile LNAPL resulting from a JP-4, JP-8, or gasoline release;
2. Known date of fuel release;
3. LNAPL resulting from of a single release confined to a relatively short period of time;
4. No, or minimal, site remediation undertaken to date;
5. Historic LNAPL analytical results, including BTEX;
6. Depth to groundwater less than 40 feet below ground surface (bgs); and
7. Department of Defense (DOD), and federal government sites preferred to general industry sites.

Identifying sites that meet all of the above-listed criteria has proven to be a difficult (ongoing) task. Consequently, the criteria served as guidelines for site selection rather than rigid selection parameters. JP-4, JP-8, or gasoline fuel release sites are preferred because of the relatively high mass fraction of BTEX present in these source fuels. Source reduction, (i.e., BTEX depletion) estimates using sampling data for the fresh product and the remaining mobile LNAPL should be more accurate for fuels with higher initial BTEX concentrations. The mobile LNAPL criterion is considered to be

met by sites that have sufficient free product thicknesses to allow collection of relatively undiluted product samples (i.e., at least 1 inch of mobile LNAPL).

Application of the second and third criteria in combination with the first criterion has eliminated numerous sites from this study. In order to determine the degree of weathering that has occurred over a given time interval, reliable information on the date of the release must be available. For many petroleum release sites, the specific date(s) of release is not documented and at best can be only approximated based on known historical site activities. In addition, one-time releases (i.e. spills) of sufficient volume to produce a long-term mobile LNAPL in the subsurface environment are rare and when such releases occur, they frequently trigger emergency response actions that compromise satisfaction of the fourth selection criterion (minimal site remediation).

Sites where limited or no site remediation has occurred are preferred for this assessment of *in situ* LNAPL weathering rates. Soil venting activities, such as soil vapor extraction (SVE), bioventing, and bioslurping are likely to increase the attenuation of the LNAPL fraction as a result of volatilization and biodegradation; therefore, BTEX weathering calculations performed for the LNAPL remaining at these sites would be biased. Sites where limited free product recovery or soil excavation has occurred, but at which measurable free product remains, are considered acceptable for this study.

Sites with historic LNAPL sampling results for BTEX may be considered in lieu of a known spill or release date. The availability of known BTEX concentrations at a known sampling time could serve as an initial point on the BTEX depletion curve. Ideally, historic LNAPL BTEX results should predate the proposed product sampling by 3 or more years to minimize the impact of sample variability.

Sites where the depth to groundwater is less than 40 feet bgs are preferred so that Geoprobe® sampling can be performed. Geoprobe® groundwater sample collection below this depth often is difficult, but will be evaluated on a site-specific basis.

Finally, DOD and federal government sites are preferred. It is expected that potential legal issues and project funding issues will be minimized if the majority of sites included in this research study are located at federal facilities. In an effort to satisfy this requirement, if an insufficient number of JP-4, JP-8, and/or gasoline release sites are identified, the first criterion may be relaxed to include JP-5 (a fuel commonly used at naval facilities) release sites, especially if other site selection criteria are met by the candidate JP-5 site. Sections 2.2 and 2.3, respectively, list the primary and secondary candidate sites identified to date. Each listing is subject to change as information becomes available during ongoing site identification efforts. All the sites listed and discussed in Section 2.2 are located at federal facilities. The sites listed and briefly described in Section 2.3 are secondary sites that satisfy fewer of the selection criteria. These sites may be selected for the study if additional primary sites are not identified.

2.2 PRIMARY SITES

The primary sites listed and described below represent those currently identified sites that best meet the selection criteria, outlined in Section 2.1 for the proposed fuel weathering study.

2.2.1 Primary Site Listing

The primary site list for this fuel weathering study currently includes the following fuel release sites:

- Building 1610, Shaw Air Force Base (AFB), South Carolina;
- Defense Fuel Supply Point-Charleston, Hanahan, South Carolina;
- Day Tank 1, Facility 293, Cecil Field Naval Air Station, Florida; and
- General Industry Site, Myrtle Beach AFB, South Carolina.

Brief descriptions of site operation histories, physical setting, and contaminant conditions are provided in the following subsections.

2.2.2 Building 1610, Shaw AFB, South Carolina

Shaw AFB is located approximately 37 miles east of Columbia, South Carolina, along US Highway 76. Building 1610 is located in the northern portion of Shaw AFB, adjacent to the flightline. The site at Building 1610 consists of a small release area adjacent to the main jet fuel pipeline that services the flightline. In June 1994, jet fuel was discovered on the ground surface as a result of a leak in a buried, pressurized, 6-inch-diameter fuel pipeline. Based on information from facility personnel, the leak is thought to have occurred over a 5- to 6-month-period, during which the Base converted from JP-4 to JP-8 jet fuel (Roller, 1996). The released fuel is thought to be composed primarily of JP-4 jet fuel, because the conversion to JP-8 occurred in April/May 1994 (Green, 1996). A site layout for the Building 1610 release is provided on Figure 2.1.

In August 1996, the first three groundwater monitoring wells (MWs) were installed in the vicinity of Building 1610; therefore, sampling data from multiple events are not available. A groundwater investigation recently was conducted at nearby Building 1613, located approximately 1,500 feet south-southwest of the Building 1610 site (Rust Environment & Infrastructure, Inc. [Rust], 1995a). The geology at the two sites is thought to be similar. At the Building 1613 site, sandy deposits of the Duplin Formation occur from the ground surface to a depth of approximately 65 feet bgs. Underlying the Duplin Formation are clayey deposits. Groundwater at the Building 1613 site occurs at approximately 30 feet bgs and flows to the east.

Following discovery of the leak, approximately 80 tons of soil was excavated and removed from the site. Implementation of site assessment activities were begun by Rust in August 1996, and included the installation of one upgradient MW (MW1610-1) and two additional MWs (MW1610-2 and MW1610-3) downgradient from the area of the pipeline leak. MWs locations are shown on Figure 2.1. Upon completion and

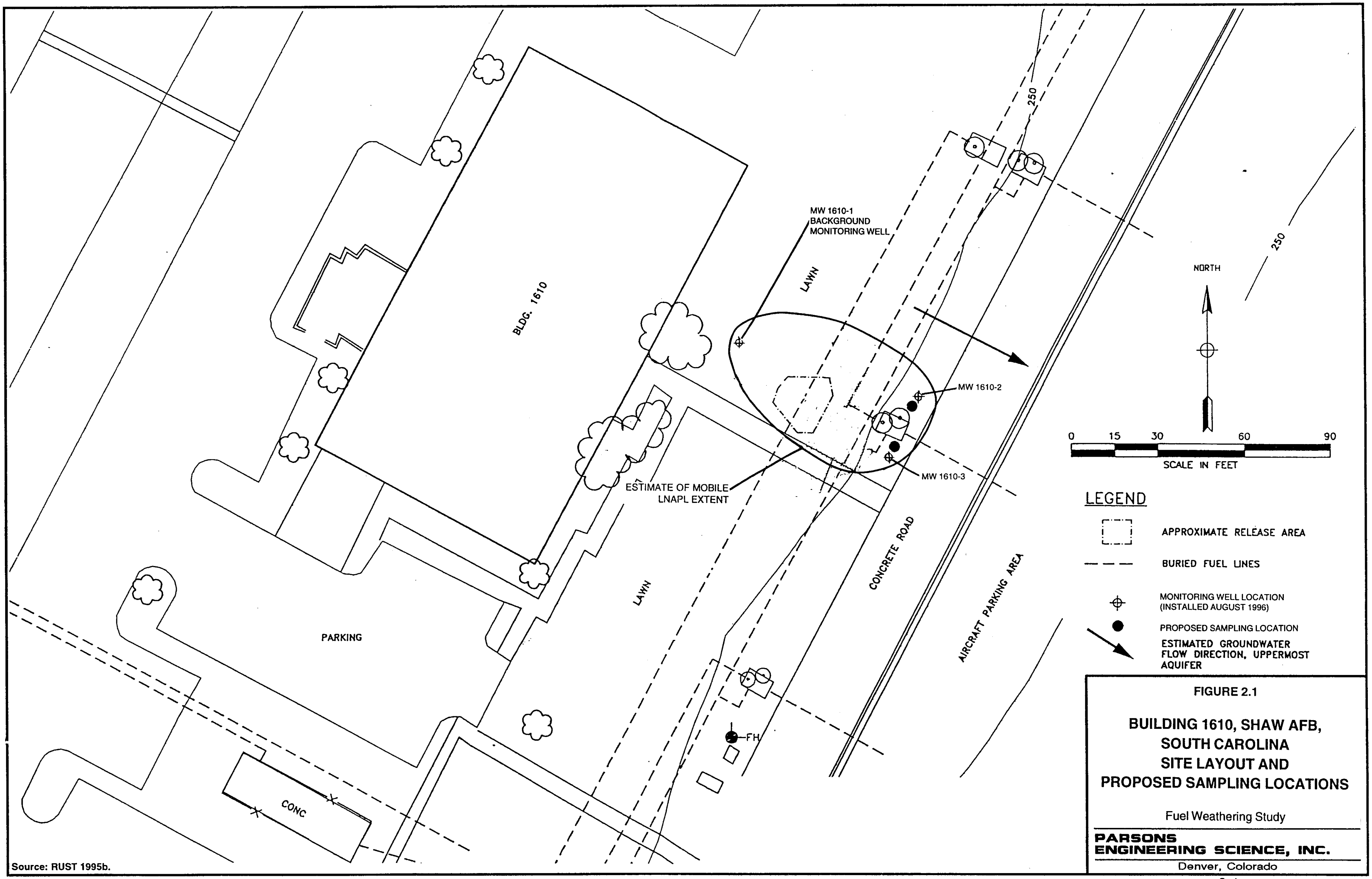

FIGURE 2.1

BUILDING 1610, SHAW AFB, SOUTH CAROLINA SITE LAYOUT AND PROPOSED SAMPLING LOCATIONS

Fuel Weathering Study

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development of the monitoring wells, free product thicknesses of approximately 2.5 feet were measured in MW1610-2 and MW1610-3 (Green, 1996). In addition, approximately 1.9 feet of free product was measured in MW1610-1. The draft site assessment report, which will include soil and groundwater sampling results is scheduled to be released in October 1996 (Rust, 1995b).

Proposed sampling locations for the Building 1610 site are shown on Figure 2.1. Sampling procedures are outlined in Section 3. South Carolina Department of Health and Environmental Control (SCDHEC) approval is required prior to Geoprobe® borehole installations that penetrate the water table.

2.2.3 Defense Fuel Supply Point - Charleston, Hanahan, South Carolina

Defense Fuel Supply Point (DFSP) - Charleston, is located in Hanahan, South Carolina near Charleston. DFSP consists of seven ASTs used to store aviation fuels. In October 1975, a leak developed in Tank 1 that resulted in the release of 83,000 gallons of JP-4 jet fuel over a 20-day period. The release triggered abatement actions and a series of environmental investigations at the site. A layout of the site is provided on Figure 2.2.

The site is underlain by unconsolidated Pleistocene sediments composed primarily of medium-grained sands with interfingering clay lenses (Chapelle *et al.*, 1996). In the Tank 1 area, the most permeable saturated sands are overlain by discontinuous 1- to 3-foot-thick clay beds. These clay beds create local semi-confined conditions for the moderately permeable sandy shallow aquifer. Groundwater flows north from the Tank 1 area, remaining under semi-confined conditions for a distance of approximately 150 feet (Chapelle *et al.*, 1996). The depth to the water table varies with the season, but was recently measured at approximately 18 to 22 feet bgs in the Tank 1 area (International Technology Corporation [IT], 1996).

The majority of information in this section was extracted from facsimile transmittals of a recent work plan assembled by IT (1996). Since the time of the release, numerous site investigations have occurred. In November 1975, the US Army Environmental Hygiene Agency (USAEHA, 1977) determined the plume area encompassed approximately 20,000 square feet in the northern portion of the storage basin at approximately 7 to 12 feet bgs. In December 1975, free product recovery was conducted at the site for 2 weeks, and approximately 21,000 gallons of JP-4 was recovered. A second attempt in 1976 to further recover free product was terminated because little jet fuel was recovered (USAEHA, 1977).

In 1987, the US Geological Survey (USGS), in cooperation with the Defense Fuel Supply Center (DFSC), began an investigation at the site to assess the potential for *ex* situ bioremediation of groundwater contamination at the site. As part of this investigation, 17 groundwater extraction wells were installed. Based on data collected from these wells, the hydrogeology of the site was determined to be more complex than previously recognized. Measurements from these wells showed free-phase jet fuel to be trapped below clay lenses beneath the water table. Jet fuel migration had occurred during periods of low water table levels caused by natural climatic conditions and exacerbated by pumping from the recovery wells (IT, 1996).

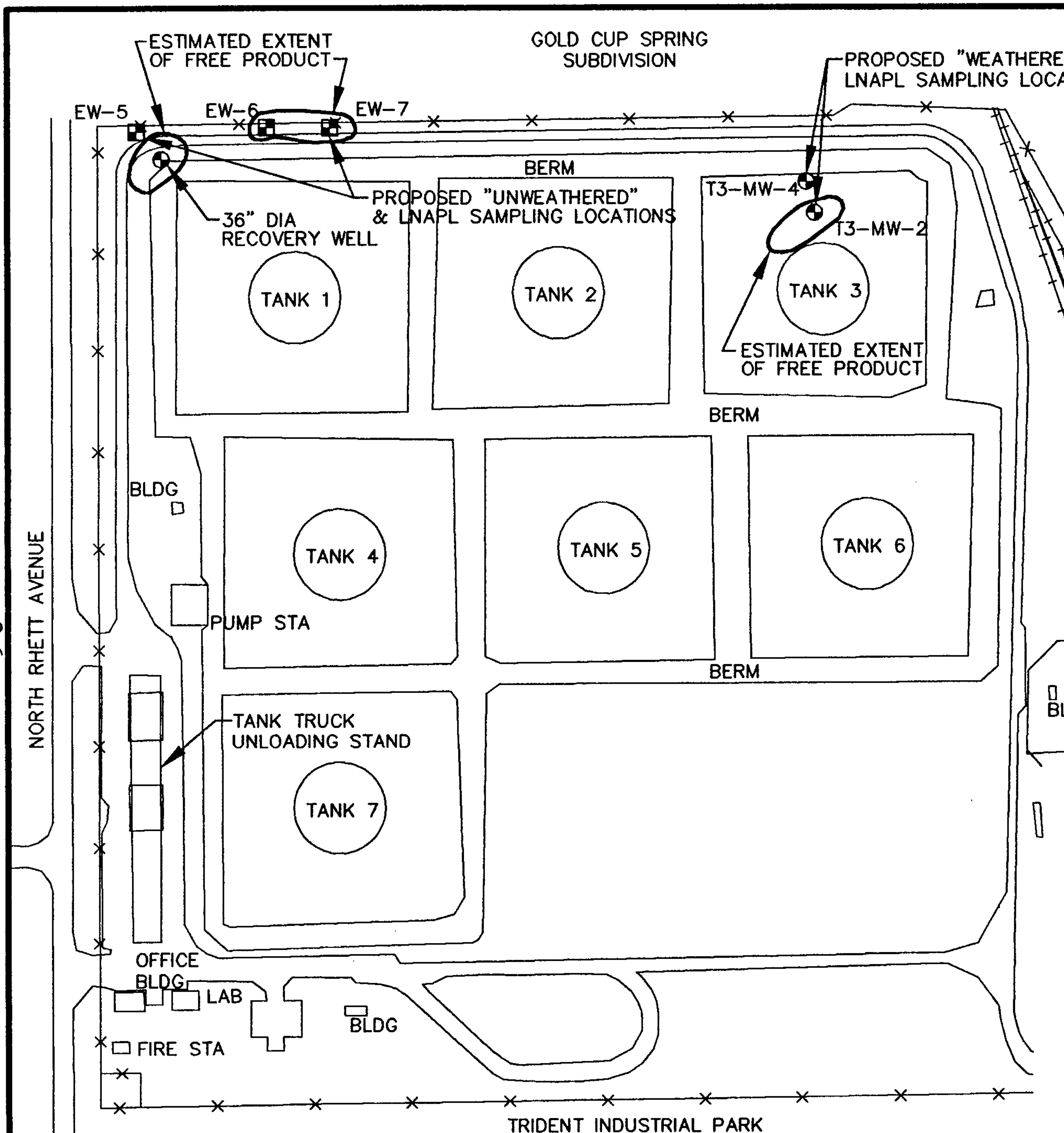

FIGURE 2.2

DFSP-CHARLESTON, HANAHAN, SOUTH CAROLINA SITE LAYOUT AND PROPOSED SAMPLING LOCATIONS

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At the time of development of this work plan, soil, groundwater, and LNAPL contamination data were not yet available from DFSC. As part of a recently published paper regarding biodegradation rates at the site, groundwater contamination levels were provided for benzene and toluene averaged over three separate quarterly sampling events (Chapelle *et al.*, 1996). Average reported benzene concentrations in groundwater were measured at 19 micrograms per liter (μg/L) at extraction well EW-7 and 74.7 μg/L at EW-6. Toluene concentrations were measured in groundwater at 345 μg/L and 223 μg/L at EW-7 and EW-6, respectively.

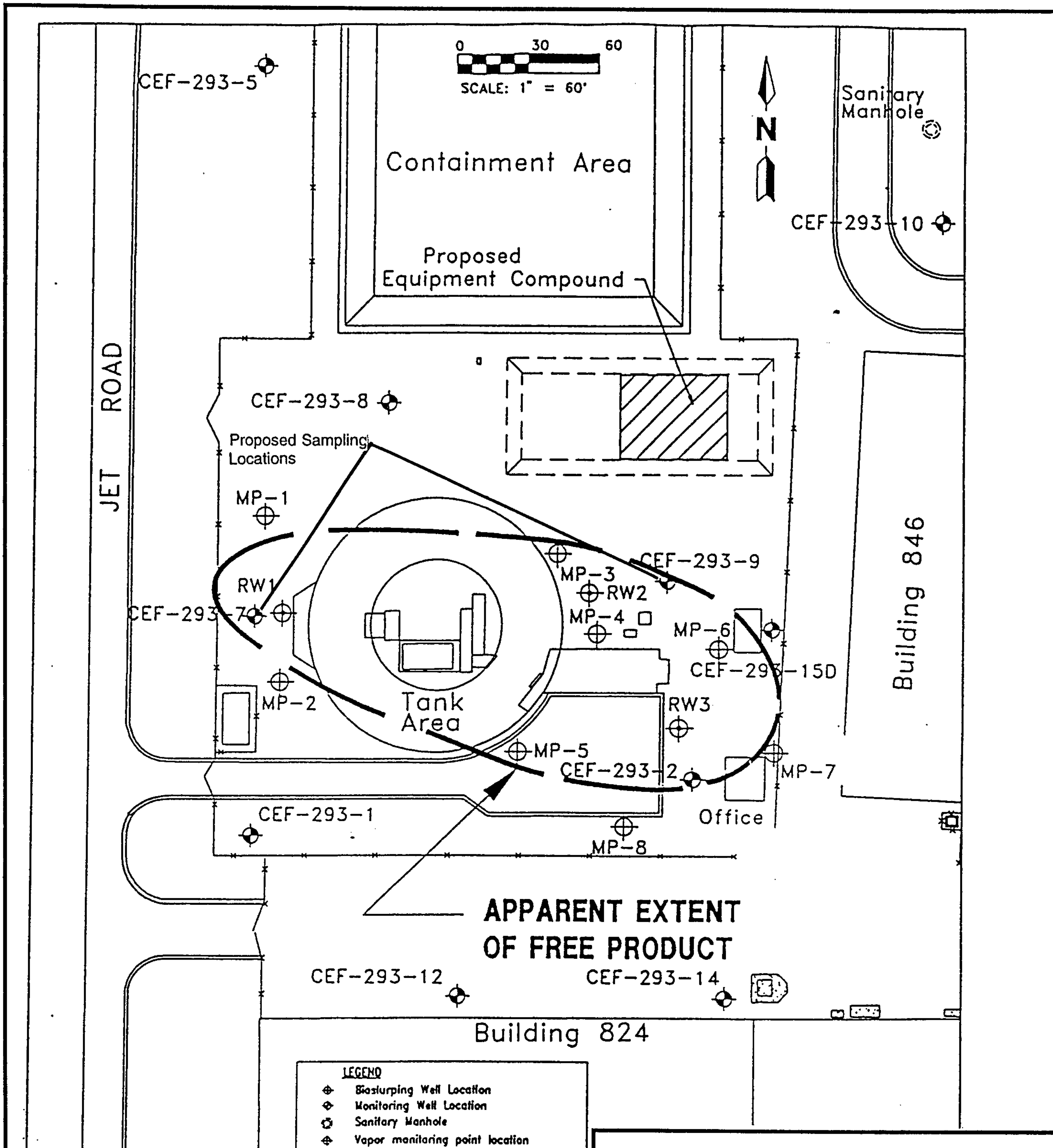
Based on information provided by DFSC personnel (Smith, 1996), mobile LNAPL is typically present at EW-6 and EW-7 and MW W-103 (EW-6 and EW-7 are shown on Figure 2.2. W-103, not shown, is approximately 10 feet west of EW-7). However, based on monthly water level and product thickness measurements performed at the site by the IT Corporation, free product has not been observed in these wells since May 1996 (IT, 1996). During the May 1996 measurement, 0.22 foot and 1.77 feet of product were observed in EW-6 and EW-7, respectively. In August 1996, approximately 0.35 foot of product was present in a 36-inch recovery well located northwest of Tank 1 (Figure 2.2).

Proposed sampling locations for this fuel weathering study are shown on Figure 2.2. In addition to soil, groundwater, and free product sampling at the Tank 1 area, proposed sampling locations also are shown at the Tank 3 area, located approximately 700 feet east of Tank 1. Free product at the Tank 3 area has been noted as being substantially weathered as compared to fuel present at the Tank 1 site (Vroblesky, 1996). While the source of the free product at the Tank 3 area is not known, it is believed to be approximately the same age as the product at the Tank 1 site (Vroblesky, 1996). Collection of samples at each of these locations may prove advantageous because the difference in weathering rates may be a function of where the LNAPL is present within the aquifer rather than spillage. Under Tank 1, the LNAPL is trapped beneath a confining clay unit whereas beneath Tank 3 LNAPL is located at the water table. As with the Shaw AFB site, SCDHEC approval is required prior to intrusive investigations that result in penetration of the water table.

2.2.4 Day Tank 1, Facility 293, Cecil Field Naval Air Station, Florida

The Cecil Field Naval Air Station (NAS) is located in Jacksonville, Florida in southwestern Duval County at the junction of Highway 228 (Normandy Boulevard) and 103rd Street. Day Tank 1, Facility 293, located east of Jet Road and north of Buildings 824 and 824A, consists of a 200,000-gallon, interior-lined, asphalt-coated, steel AST installed in 1956. In 1981, approximately 497,000 gallons of JP-5 jet fuel was released at this site when the tank was overfilled. Facility personnel reported at the time that more than one-half of the released JP-5 was recovered following the spill (ABB Environmental Services [ABB], 1994). Free product present at this site also may be associated with other possible releases resulting from damage to the underground fuel distribution pipeline and junction box adjacent to the tank, and structural damage to the tank itself (ABB, 1994). A layout of the site is provided on Figure 2.3.

The specific geology and hydrogeology for the Day Tank 1 site was not available at the time of work plan development. Unless otherwise indicated, geologic information provided below is from the North Fuel Farm Contamination Assessment Report



Source: ABB, 1995.

FIGURE 2.3

DAY TANK 1, FACILITY 293, CECIL FIELD NAS, FLORIDA SITE LAYOUT AND PROPOSED SAMPLING LOCATIONS

Fuel Weathering Study

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Addendum (ABB, 1996). The North Fuel Farm is located approximately 4,000 feet north of the Day Tank 1 site. Sediments at the North Fuel Farm are composed of silty, fine-grained sand and silty sand with trace amounts of clay in the shallow water table zone. The shallow water table at the North Fuel Farm ranges between 2 and 15 feet bgs. Sediments in the surficial aquifer zone, which extends from 15 to 50 feet bgs, are composed of fine-grained silty sand. Based on summarized results reported in the remedial action plan (RAP) for the Day Tank 1 site (ABB, 1994), depth to water in the surficial aquifer at the site ranges from 5 feet to 8 feet bgs and the overall groundwater flow direction is toward the east-southeast.

Unless otherwise stated the following information was taken from the RAP for Day Tank 1 prepared by ABB (1994). In 1981, Geraghty & Miller conducted a preliminary contamination assessment (CA) at the Day Tank 1 facility and concluded that JP-5 fuel was present only in the unsaturated zone and had not migrated into groundwater at the site. The CA report concluded that the fuel would naturally biodegrade over time; therefore, the only remedial action taken was the addition of fertilizer to site soils to enhance fuel biodegradation.

In December 1990, a second CA was initiated at the site by ABB and involved the installation of 15 shallow MWs (CEF-293-01 through CEF-293-14 and CEF-293-16) and one deep MW (CEF-293-15D). After completion of the CA, the Florida Department of Environmental Protection (FDEP) requested additional subsurface assessment activities, which resulted in additional soil sampling and installation of two additional monitoring wells (CEF-293-17D and CEF-293-18) in October 1993. Soil samples collected from eight soil borings were found to have elevated headspace readings of volatile organic compounds (VOCs) (greater than 50 parts per million volume per volume [ppmv] using an organic vapor meter [OVM]). Contamination distribution maps developed from September 1993 groundwater sampling results show benzene, total aromatic VOCs, and napthalene concentrations exceeding 20 milligrams per liter (mg/L), 50 mg/L, and 50 mg/L, respectively, in the area encompassed by monitoring wells CEF-293-2, CEF-293-7, and CEF-293-9 (Figure 2.3). The apparent extent of free product as of July 1995 is shown on Figure 2.3. Free product thicknesses, as measured on August 12, 1996, were 0.59 foot and 0.78 foot at monitoring wells CEF-293-7 and CEF-293-9 (Klimas, 1996).

In August 1995, ABB (1995) submitted an alternate procedures request for the Day Tank 1 site proposing bioslurping as the preferred method of free product recovery. At present, three 1-day bioslurping pilot tests have been performed at the site (Ullo, 1996).

Proposed sampling locations for the Day Tank 1 site are shown on Figure 2.3. Sampling procedures are outlined in Section 3. Because the contamination is located in an active part of the NAS, general Navy regulations must be observed in obtaining security clearance for Geoprobe® operators and sampling personnel. Any FDEP approvals required will be obtained prior to sampling activities.

2.2.5 General Industrial Site, Former Myrtle Beach AFB, South Carolina

Former Myrtle Beach AFB, South Carolina is located on the southwest side of the City of Myrtle Beach between the Intracoastal Waterway and the Atlantic Ocean. The

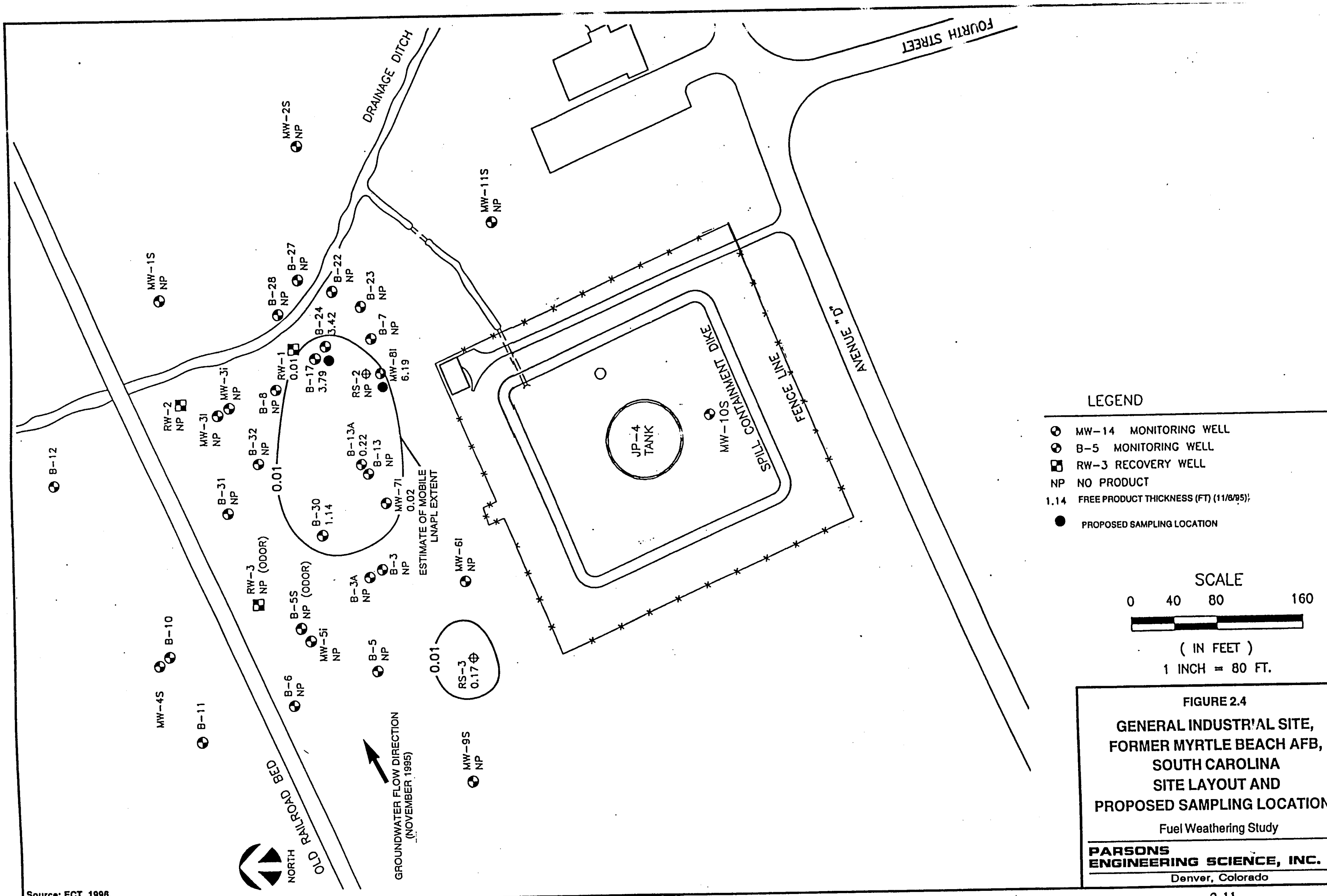
spill site is located on the south side of former Myrtle Beach AFB, near the intersection of Avenue D and Fourth Street. On January 15, 1981, a spill of approximately 123,000 gallons of JP-4 jet fuel occurred during fuel transfer from a barge on the Intracoastal Waterway to a privately-owned AST located on Myrtle Beach AFB property. Shortly after the spill, a french drain system was installed and approximately 21,000 gallons of the spilled JP-4 was recovered. The drain system was deactivated in July 1982 (Environmental Consulting and Technology, Inc. [ECT], 1996). A layout of the site is provided on Figure 2.4

A fairly uniform clay layer exists at the site from the ground surface to approximately 7 to 9 feet bgs. This clay layer has a low permeability and acts as a confining layer for the underlying shallow aquifer (ECT, 1996). The clay layer is underlain by a highly permeable sand with shell fragments to approximately 30 feet bgs. Clayey sand with lenses of fine sand and clay occur from 30 to 40 feet bgs. This deeper clay sand is similar to the surface clay in that it limits vertical migration. Potentiometric surfaces for the shallow confined aquifer were measured by ECT in 1992 and 1993. Potentiometric surfaces measured as high as 5 feet above the base of the clay and as low as 0.5 foot above the base of the clay depending upon the amount of seasonal precipitation (ECT, 1996). Potentiometric surface measurements conducted in November 1995 indicated a northeasterly groundwater flow direction (ECT, 1996).

Information presented below was taken from the ECT (1996) Draft Groundwater Mixing Zone and Monitoring Plan Application for the site. In July 1982, a product recovery system consisting of 10 vacuum extraction wells was installed at the site and operated until November 1982. During this time, the recovery system collected less than 100 gallons of free product. Water level and free product measurements conducted by Westinghouse Environmental & Geotechnical Services (WEGS) between 1982 and 1985 indicated potential migration of free product to the east of the original spill area. A groundwater treatment system and associated interceptor trenches were installed during March and April 1990, and operation of the system began in September 1990. Treatment system effluent failed to meet National Pollution Discharge Elimination System (NPDES) permit requirements, and the system was deactivated in November 1990.

In August 1991, ECT was contracted to conduct a site assessment for the facility. As part of the site assessment, soil samples were collected and field-screened for organic vapors, 19 monitoring wells were installed (10 shallow, 6 intermediate, and 3 deep), free product thicknesses were measured, and groundwater samples were collected for laboratory analyses. The greatest free product thicknesses (approximately 4 feet) were measured below the shallow clay layer between MWs B-7 and B-30 (Figure 2.4). No free product was measured in any of the MWs screened entirely within the surficial clay layer (MW-6C, MW-7C, and MW-8C).

Following completion of the site assessment, ECT began installation of a free product recovery system in March 1992. Three recovery trenches were excavated below the base of the shallow clay layer, and collection sumps, skimmers, and axial pumps were installed. System operation began in May 1992 and continued intermittently until November 1993. Total fuel recovered during this time was 720 gallons. Following the 1992 recovery effort, ECT estimated that approximately 12,000 to 13,000 gallons of free product remained trapped below the clay layer. Free product



Source: ECT, 1996.

FIGURE 2.4

GENERAL INDUSTRIAL SITE,
FORMER MYRTLE BEACH AFB,
SOUTH CAROLINA
SITE LAYOUT AND
PROPOSED SAMPLING LOCATIONS

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bail down tests conducted in 1992 and 1993 indicated free product recovery rates ranging between 0.003 and 0.015 gallon per day, several orders of magnitude slower than typical groundwater recovery rates. During 1992 and 1993 field tests, a visual comparison of recovered fuel from the site with "fresh" JP-4 suggested little weathering of the product trapped below the clay.

In March 1994, ECT submitted a corrective action plan for the spill site that proposed groundwater recovery and aboveground treatment using air stripping and carbon polishing as the preferred remedial alternative. In September 1995, SCDHEC, recommended that groundwater MWs be resampled to confirm that the free product and dissolved plumes were fully defined. ECT returned to the site in November 1995, and resampled MWs. During this investigation, free product was observed in the same monitoring wells as the March 1992 investigation, except that free product was not observed in monitoring well B-3A. The extent of free product and measured thicknesses from the November 1995 investigation are presented on Figure 2.4. Overall, concentrations of JP-4 constituents detected in groundwater samples collected during this latest sampling event were significantly lower than concentrations detected during the October 1991 sampling event (ECT, 1996). Based on the results of the November 1995 sampling event and the limited success of free product recovery in the past, ECT felt the site met groundwater mixing zone criteria under South Carolina water classifications and standards (Regulations 61-68) and applied for monitoring only as a site remedy.

Proposed sampling locations for the spill site are shown on Figure 2.4. Sampling and analysis procedures are outlined in Section 3. SCDHEC approval is required prior to conducting intrusive sampling activities.

2.3 SECONDARY SITES

The sites listed and briefly described below are secondary candidates that may be selected for the fuel weathering study if additional primary sites are not identified. The secondary sites meet fewer site selection criteria than the primary sites previously discussed.

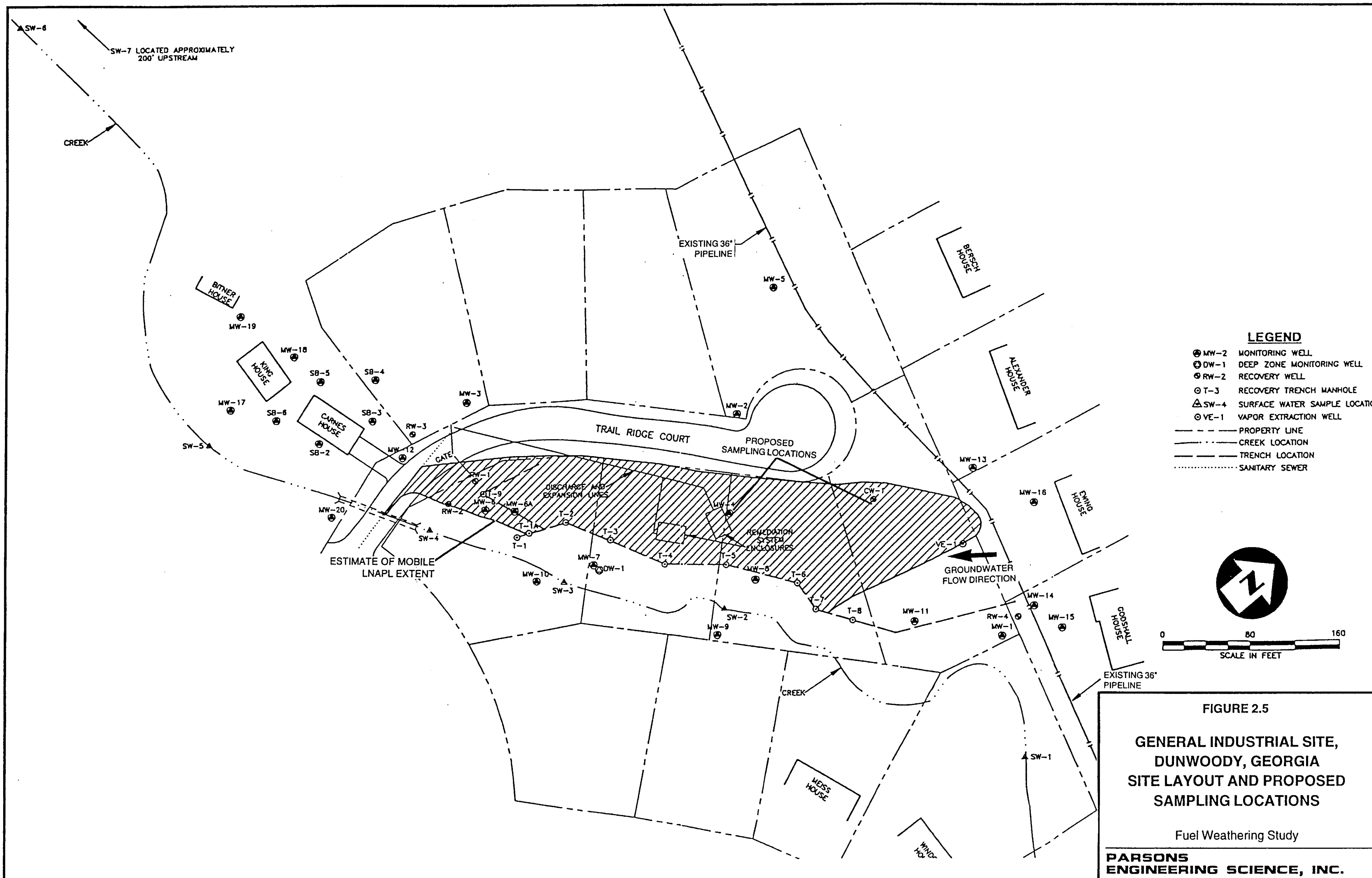
2.3.1 Secondary Site Listing

The secondary candidate site list for this fuel weathering study currently includes the following release sites:

- General Industrial Site, Dunwoody, Georgia
- General Industrial Site, Charlotte, North Carolina
- General Industrial Site, Port Clinton, Ohio

2.3.2 General Industrial Site, Dunwoody, Georgia

This industrial site consists of a release from a 36-inch-diameter underground petroleum pipeline located within a subdivision in Dunwoody, Georgia (See Figure 2.5). In February 1971, a hairline crack was discovered in the pipeline and repaired.



Source: Parsons ES, 1995.

FIGURE 2.5

GENERAL INDUSTRIAL SITE,
DUNWOODY, GEORGIA
SITE LAYOUT AND PROPOSED
SAMPLING LOCATIONS

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The duration of the product leak prior to pipeline repair is not known, but it appears that product leaked at a very low rate for an extended period of time (Parsons ES, 1995b). The released product was composed primarily of gasoline; however, some fuel oil also may have been released prior to discovery of the leak (Gillis, 1996). Radial product collection ditches and an interceptor trench were excavated in 1972 and 1973, and 668 barrels of product was recovered by 1975 (Parsons ES, 1995b). Groundwater at the site occurs between 10 and 40 feet bgs. The extent of LNAPL at the site is shown on Figure 2.5, as are proposed sampling locations should this site be included in the study.

2.3.3 General Industrial Site, Charlotte, North Carolina

The industrial site located in Charlotte, North Carolina is owned by a commercial petroleum company. The site layout and the original leak location are shown on Figure 2.6. A leaded gasoline release of an unspecified volume is thought to have occurred between 1981 and 1989, when a faulty weld in a vapor recovery unit at the site was discovered. Company officials believe the weld may have begun leaking soon after vapor recovery unit installation in 1981 (Eaton, 1996).

Groundwater at the site occurs at approximately 26 feet bgs. The site geology is composed of a few inches of organics and silty clays at the surface, underlain by a few feet of residual soil composed of clays and silts. The residual soil grades into a saprolitic soil consisting of clay, silt, and sand grains that retain the structure of the original unweathered bedrock (Klem, 1996).

Free product recovery and total fluids recovery began at the site in early 1994, as did SVE. Air sparging points placed between monitoring wells MW-17 and MW-18 (Figure 2.6) began operation in August 1996. Officials for the petroleum company and their environmental consultant, S&ME (1994), believe groundwater and soils in the vicinity of MW-21 have not been significantly impacted by SVE operation at the site because of the relatively low-permeability saprolite in the vadose zone. As of August 1996, approximately 1.5 feet of free product was observed in monitoring well MW-21, the proposed product sampling location for this site (Figure 2.6).

2.3.4 General Industrial Site, Port Clinton, Ohio

The industrial site at Port Clinton, Ohio is the site of a former service station at which approximately 1,000 gallons of gasoline was reported to have been released in 1978. A layout of the site is provided on Figure 2.7.

The site is located in the glaciated Lake Erie plain of north central Ohio. The regional geology consists of discontinuous lake deposits of silts and fine sands underlain by limestone bedrock (Wieckowski, 1996). Well MW-1 was installed on service station property in January 1991, and free product was discovered floating on the water table 2 weeks after installation of the well. No active remediation has been performed at the site. Free product samples were collected from monitoring well MW-1 and recovery well RW-1 in December 1993 and June 1995, respectively, to characterize the free product. BTEX mass fractions were determined during both sampling events. Recent groundwater measurements collected at the site (May 1996) indicated no

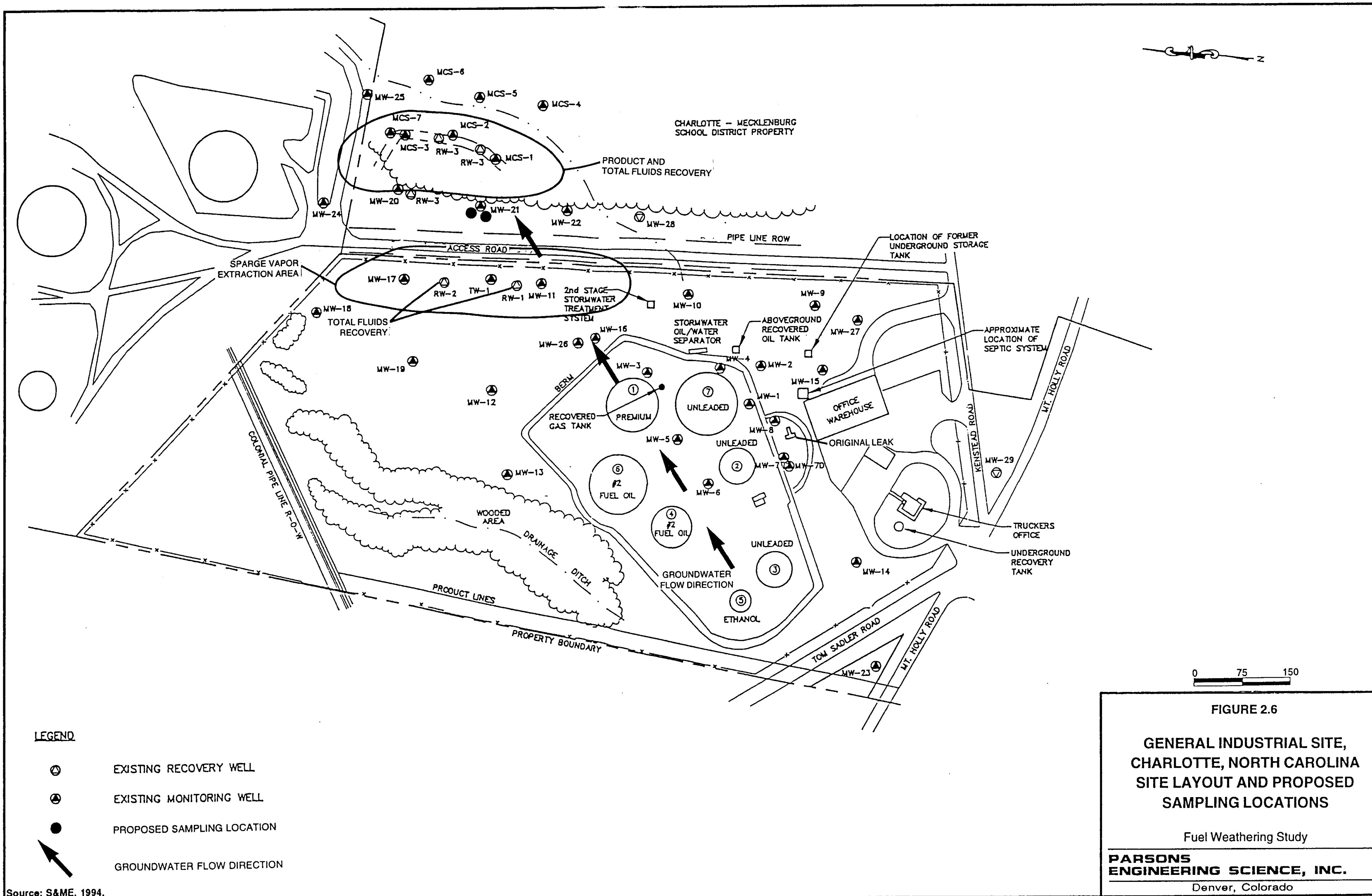

FIGURE 2.6

GENERAL INDUSTRIAL SITE, CHARLOTTE, NORTH CAROLINA SITE LAYOUT AND PROPOSED SAMPLING LOCATIONS

Fuel Weathering Study

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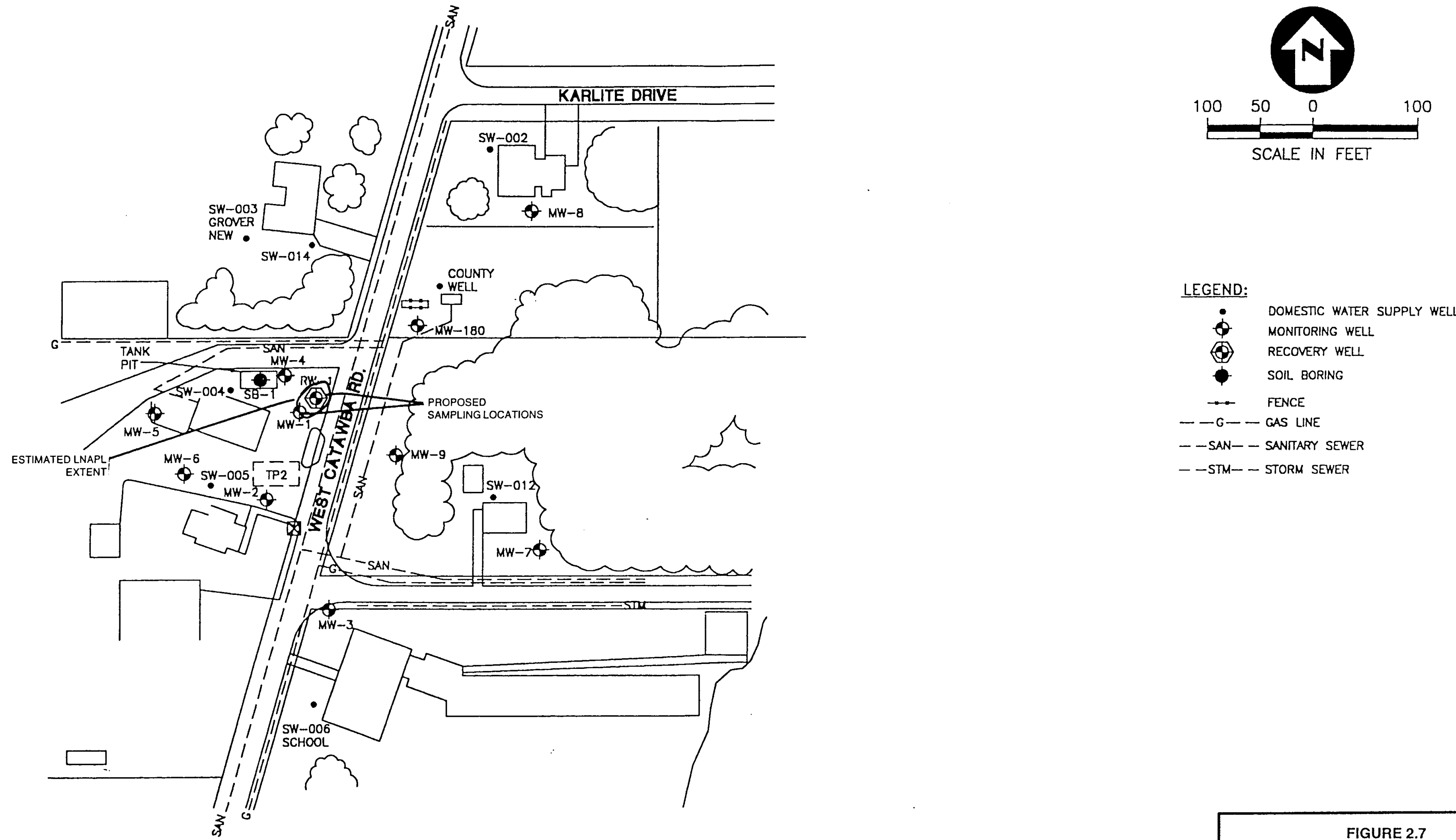

Source: WiecKowski, 1996.

FIGURE 2.7

GENERAL INDUSTRIAL SITE,
PORT CLINTON, OHIO
SITE LAYOUT AND PROPOSED
SAMPLING LOCATIONS

Fuel Weathering Study

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floating free product in MW-1; however, free product sample collection is possible from recovery well RW-1, the proposed sampling location (Figure 2.7).

2.4 ADDITIONAL SITES

The fuel weathering study also will incorporate the results of soil, groundwater, and free product samples previously collected from recent JP-8 spill sites at Seymour Johnson AFB, North Carolina, and Pope AFB, North Carolina. Both of these sites, were sampled by the US Army Corps of Engineers in July 1996. In addition, the study will incorporate the results of groundwater and soil samples collected at the KC-135 Crash Site at Wurtsmith AFB, Michigan. Mobile free product was not found during the Summer 1996 sampling event at Wurtsmith AFB.

SECTION 3

COLLECTION OF SITE DATA

To assess the effects of mobile and residual LNAPL weathering as they apply to soil and groundwater, samples of each medium (i.e., soil, groundwater, and free product) will be collected from each of the selected study sites outlined in Section 2. Wherever possible, soil, groundwater, and free product samples will be collected from the same borehole using the Geoprobe® system (in accordance with the general procedures outlined in Section 3.2). Sampling from the same borehole is desired in order to determine weathering effects on mobile LNAPL and its relation to contaminants in soil at the capillary fringe and in groundwater, within the same vertical continuum. Table 3.1 presents the analytical protocols for soil, free product, and groundwater samples.

Determination of BTEX concentrations in soil, groundwater, and free product samples represents the primary analysis to be used to determine the impacts of natural weathering processes. The concentration of naphthalene and methyl naphthalene also will be determined in each media type. In addition, TPH concentration in soil and soil moisture will be determined to allow comparison of weathering effects on the mobile LNAPL with weathering effects on residual LNAPL present in capillary fringe soils. Dissolved BTEX concentrations in groundwater will be analyzed to determine the extent of contaminant partitioning from the LNAPL to the groundwater and whether contaminant equilibrium between the LNAPL source and groundwater exists.

The following sections describe the procedures that will be followed when collecting site-specific data. Methods for collection of water level measurements prior to site sampling are described in Section 3.1. Geoprobe® procedures for collection of soil, groundwater, and free product are described in Section 3.2. Procedures to be used for the installation of temporary groundwater monitoring points, if necessary, are described in Section 3.3. Procedures to be used to collect free product and groundwater samples are described in Section 3.4. Sample handling procedures are described in Section 3.5. Site restoration procedures are described in Section 3.6, and equipment decontamination procedures are discussed in Section 3.7.

3.1 WATER LEVEL AND FREE PRODUCT THICKNESS DETERMINATION

Prior to performing sampling activities at a site, free-phase product thicknesses and static water levels will be measured at site monitoring wells in the immediate vicinity of the proposed sampling locations shown on site figures in Section 2. An oil/water

TABLE 3.1
ANALYTICAL PROTOCOLS FOR
SOIL, FREE PRODUCT, AND GROUNDWATER SAMPLES
Fuel Weathering Study

MATRIX	NUMBER OF SAMPLES PER SITE	LABORATORY	ANALYSIS	METHOD
SOIL	2	NRMRL	BTEX + TMBs[a/]	NRMRL equivalent to USEPA SW8020A[b/]
			TPH[c/]	NRMRL equivalent to USEPA SW8015, modified for diesel and gasoline
			Napthalene and Methyl Napthalenes	NRMRL equivalent to USEPA SW8270
			Moisture	ASTM D-2216[d/]
FREE PRODUCT (MOBILE LNAPL)	4	2 to NRMRL and 2 to EAL[e/]	<u>Analysis by NRMRL</u>	
			BTEX + TMBs	GC/MS (Direct Injection)
			Napthalene and Methyl Napthalenes	NRMRL equivalent to USEPA SW8270
			<u>Analysis by EAL[f/]</u>	
			BTEX	USEPA SW8020
GROUNDWATER	2	NRMRL	BTEX + TMBs	RSKSOP equivalent to USEPA E602
			Napthalene and Methyl Napthalenes	NRMRL equivalent to USEPA SW8270

[a/] BTEX = benzene, toluene, ethylbenzene, and total xylenes; TMBs = trimethylbenzene isomers.
[b/] NRMRL = USEPA National Risk Management Research Laboratory, Ada, Oklahoma; USEPA = US Environmental Protection Agency method.
[c/] TPH = total petroleum hydrocarbons.
[d/] ASTM = American Society for Testing and Materials method.
[e/] EAL = Evergreen Analytical Laboratory, Wheat Ridge, Colorado.
[f/] EAL will combine free product and distilled water in a single bottle and analyze water and free product following development of equilibrium conditions.

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interface probe will be used to measure the depth to free product, the apparent free product thickness, and the depth to groundwater to the nearest 0.01 foot. Water level and free product measurements in each well will be recorded in the field notebook. Based on these measurements, soil, groundwater, and free product sampling depths will be selected.

3.2 GEOPROBE® SAMPLING FROM A SINGLE BOREHOLE

Unless otherwise indicated, soil, groundwater, and free product samples will be collected from the same borehole using a Geoprobe® system. Geoprobe® is a hydraulically powered percussion/probing machine capable of advancing sampling tools through unconsolidated soils. This system allows rapid collection of soil, soil gas, mobile LNAPL, or groundwater samples at shallow depths while minimizing the generation of investigation-derived waste (IDW). Figure 3.1 is a diagram of the Geoprobe® system. This section describes the sampling procedures to be followed when using the Geoprobe®. Sections 3.3 and 3.4 provide more detail on alternative groundwater and free product sampling procedures to be followed if site conditions preclude the use of the Geoprobe® for sampling these media.

Three general procedures will be used to collect soil, groundwater, and free product using the Geoprobe®. Soil samples from the capillary fringe will be collected first, as described in Section 3.2.1. A groundwater sample from below the mobile LNAPL layer will be collected next, and free product samples will be collected last. The groundwater and free product sampling methods are described in Section 3.2.2.

Base or facility personnel will be responsible for identifying the location of all utility lines, fuel lines, or any other underground infrastructure prior to any sampling activities. All necessary digging permits will be obtained through Base or facility personnel prior to mobilizing to the field. If necessary, Base or facility personnel also will be responsible for acquiring drilling and monitoring point installation permits for the proposed locations. Parsons ES will provide trained operators for the Geoprobe®.

3.2.1 Soil Sampling

The main purpose of soil sampling for this study is to evaluate soil BTEX and TPH contamination in soils directly above areas containing mobile LNAPLs. It is anticipated that residual petroleum contamination within capillary fringe soils will be further attenuated (weathered), as a result of increased volatilization and biodegradation, than will the underlying mobile LNAPL.

3.2.1.1 Soil Sampling Locations

Soil samples will be collected at two locations at each of the selected sites. The proposed sampling locations shown on the site figures in Section 2 were selected based upon the most recently available site information regarding free product location and thickness. Soil samples will be collected in locations where free product thicknesses are expected to be the greatest. To maximize the possibility of obtaining soil samples

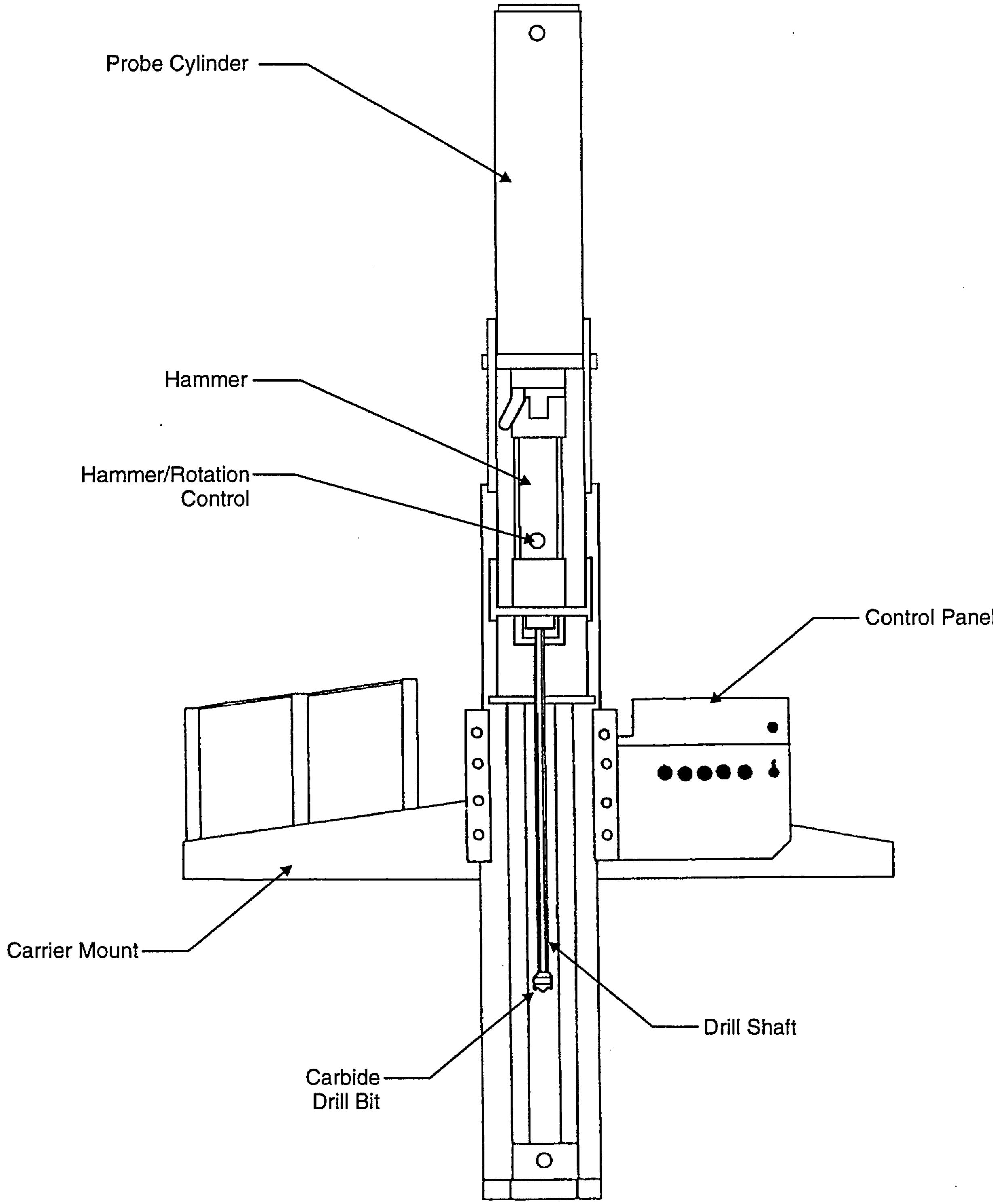

FIGURE 3.1

CROSS-SECTION OF GEOPROBE®

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within areas of measurable free product, boreholes will be placed as close as possible to MWs displaying maximum free product thicknesses for the site.

3.2.1.2 Soil Sampling Procedures

One soil sample will be collected from each of the two sampling locations at each site. The samples will be collected above the water table over a 2-foot sampling interval within the capillary fringe. Soil samples will be collected using a Geoprobe® 2-foot-long, large-bore soil sampler. The large-bore sampler serves as both the driving point and the sample collection device, and is attached to the leading end of the probe rods.

The sampler will be pushed or driven to a depth approximately 2 to 3 feet above the water table, the piston stop-pin will be removed to open the sampling barrel, and the sampler will be pushed into the undisturbed capillary fringe soils above the water table. The probe rods will be retracted, bringing the sampling device to the surface. The clear plastic liners inside the sampling barrel will be removed to allow lithologic logging, determination of whether residual free product is present in the soil, determination of headspace volatile organic compound (VOC) concentrations, and sample preparation for laboratory analysis.

The Parsons ES field scientist will be responsible for observing all field investigation activities, maintaining a detailed descriptive log of all subsurface materials recovered during soil coring, photographing representative samples, and properly labeling and storing samples. An example geologic boring log form is presented as Figure 3.2. The descriptive log will contain:

- Sample interval (top and bottom depth);
- Sample recovery;
- Presence or absence of a free product layer;
- Presence or absence of contamination as determined by headspace VOC analysis with an OVM or a photoionization detector (PID);
- Lithologic description, including relative density, color, major textural constituents, minor constituents, porosity, relative moisture content, plasticity of fines, cohesiveness, grain size, structure or stratification, relative permeability, and any other significant observations; and
- Depths of lithologic contacts and/or significant textural changes measured and recorded to the nearest 0.1 foot.

Following the removal of the clear plastic liner from the Geoprobe® soil sampler, an ultraviolet (UV) light will be used to determine if residual fuel contamination is present in the soil sample. Without removing the soil sample from the plastic liner, the UV light will be used to check for fluorescence that is indicative of a fuel layer in soil. The

GEOLOGIC BORING LOG

BORING NO.: ______ CONTRACTOR: ______ DATE SPUD: ______
CLIENT: AFCEE RIG TYPE: ______ DATE CMPL.: ______
JOB NO.: 729691.35720 DRLG METHOD: ______ ELEVATION: ______
LOCATION: ______ BORING DIA.: ______ TEMP: ______
GEOLOGIST: ______ DRLG FLUID: ______ WEATHER: ______
COMENTS: ______

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1											
	5											
	10											
	15											
	20											
	25											
	30											
	35											

NOTES

bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE

D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.2

GEOLOGIC BORING LOG

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UV light also will be used to check the fluorescence of soils caught in the sampler cutting shoe.

A small portion of each soil sample will be used to estimate concentrations of VOCs in the soil headspace, while the larger portion of the soil sample will be prepared for shipment to a fixed-base laboratory for analysis. Soil for headspace VOC analysis will be obtained from either the sampler cutting shoe or by cutting off a 1- to 2-inch section of the clear plastic liner containing the sample core and removing the soil from this smaller section. Each headspace VOC screening sample will be placed in a sealed plastic bag or mason jar and allowed to sit for at least 5 minutes. VOC concentrations in the soil headspace will then be determined using an OVM or PID, and the results will be recorded in the field records by the Parsons ES field scientist.

The larger segment of the soil-filled plastic liner (a minimum 6-inch-long section) will be submitted to the USEPA National Risk Management Research Laboratory (NRMRL) in Ada, Oklahoma for soil analyses using the methods listed in Table 3.1. Sample handling and preservation procedures are discussed in Section 3.5.

3.2.2 Groundwater and Free Product Sampling

The primary objective of free product sampling for this study is to determine the impact of weathering processes on the mobile LNAPL. In addition, groundwater samples will be collected to evaluate partitioning of BTEX contaminants into groundwater below the oil/water interface to evaluate whether an equilibrium relationship exists between the mobile LNAPL and groundwater at the site.

3.2.2.1 Free Product and Groundwater Sampling Locations

Free product and groundwater samples will be collected from two locations at each of the selected sites. Every attempt will be made to collect free product and groundwater samples from the same two Geoprobe® boreholes from which soil samples are collected for laboratory analysis (see Section 3.2.1). From each sampling location, two free product samples and one groundwater sample will be collected. A total of four free product samples and two groundwater samples will be collected from each site selected for the study.

3.2.2.2 Free Product and Groundwater Sampling Procedures

This section describes the procedures for collection of free product and groundwater quality samples from the Geoprobe® boreholes. In the event, sampling cannot be performed with the Geoprobe®, efforts will be made to install temporary monitoring points (see Section 3.3) for free product and groundwater sampling. If neither of the above methods are feasible based on Geoprobe® limitations and/or site conditions, sampling may be performed from existing site monitoring wells known to contain free product (see Section 3.4).

After collection of soil samples from the capillary fringe (Section 3.2.1), the Geoprobe® will be used to advance a 2-inch, hollow, drive rod with a sacrificial steel drive point to a depth approximately 2 feet below the water table. Then 1-inch-

diameter polyvinyl chloride (PVC) casing with a 5-foot-long section of factory-slotted well screen on the leading edge will be inserted through the hollow drive rod. The drive rod will be disengaged from the drive point and retracted 1 foot so that the PVC well screen is exposed to the formation and groundwater below the free product layer. A groundwater sample will be collected from this point using either a peristaltic pump or a mini-bailer following adequate purging (see Sections 3.2.2.2.2 and 3.2.2.2.3).

Following collection of the groundwater sample, the hollow drive rod will be fully retracted so that the screen is fully exposed across the water table and the capillary fringe. After an adequate stabilization period, the free product thickness will be measured with an oil/water probe, and a free product sample will be collected. Figure 3.3 illustrates the Geoprobe® sampler in groundwater sample collection mode, and free product measurement and sample collection mode.

In order to maintain a high degree of QC during the proposed sampling events, sampling will be conducted by qualified scientists and technicians from Parson ES who are trained in the conduct of groundwater and free product sampling, records documentation, and chain-of-custody procedures. In addition, sampling personnel will have thoroughly reviewed this work plan prior to sample acquisition and will have a copy of the work plan available onsite for reference. Detailed sampling and sample handling procedures are presented in the following subsections.

3.2.2.2.1 Preparation for Sampling

All equipment to be used for sampling will be assembled and properly cleaned and calibrated (if required) prior to arriving in the field as described in Section 3.7. In addition, all record-keeping materials will be gathered prior to leaving the office.

3.2.2.2.2 Purging

Before collecting the groundwater sample using the Geoprobe®, the exposed segment of the temporary PVC screen will be purged using a peristaltic pump and high-density polyethylene (HDPE) tubing. The tubing will be slowly lowered through the temporary PVC casing to below the free product layer. Using a low peristaltic pump flow rate, a minimum of 3 casing volumes will be purged from the point with purging continuing until equilibrium conditions are achieved. Equilibrium conditions will be assessed using a flow-through cell and field instruments. Free product within the monitoring point will be subjected to increased volatilization as compared to free product within the formation; therefore, 1 casing volume of free product will be purged prior to sampling. All purge waters and free product will be collected in accordance with facility procedures for disposal by facility personnel.

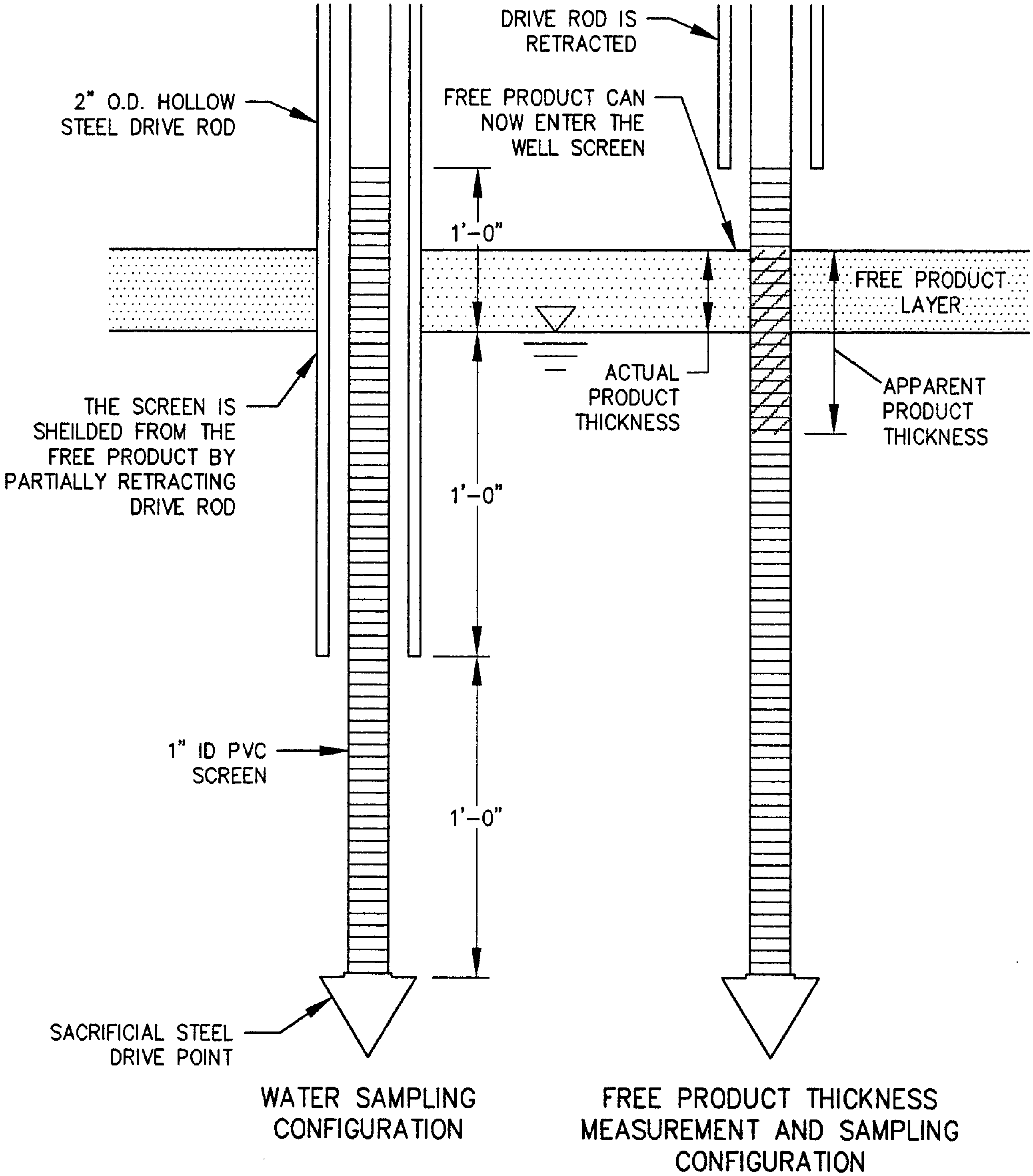

FIGURE 3.3

GEOPROBE® SAMPLING OF GROUNDWATER AND FREE PRODUCT

Fuel Weathering Study

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

3.2.2.2.3 Sample Extraction

Groundwater and free product samples will be collected using a peristaltic pump. Sample extraction procedures will be conducted in a manner that minimizes contaminant loss through volatilization. Following purge and recovery, new HDPE tubing will be slowly lowered through the temporary PVC casing to prevent splashing. The groundwater sample will be transferred directly from the tubing into the appropriate volatile organic analysis (VOA) sample container. The water will be carefully poured down the inner walls of the sample bottle to minimize aeration of the sample. Sample containers will be completely filled so that no air space remains in the container. Excess groundwater collected during sample extraction will be collected for proper disposal by facility personnel.

Free product sampling using the Geoprobe® will be conducted after the groundwater sample has been collected following the same procedures outlined above. However, extra care will be taken in lowering the tubing slowly into the casing (rate not to exceed 0.5 foot per minute) to minimize splashing of free product. Only one casing volume of free product will be purged prior to sampling; therefore, excess free product generated by sampling should be minimal. Excess free product will be collected and disposed of in accordance with facility procedures.

3.2.2.3 Free Product and Groundwater Sample Analysis

Two free product samples and one groundwater sample will be collected in VOA bottles from each sampling location. A total of four free product samples and two groundwater samples will be collected per site, unless otherwise specified. The groundwater sample and one of the free product samples from each location will be submitted to the NRMRL in Ada, Oklahoma for the analyses listed in Table 3.1. The remaining free product sample from each sampling location will be sent to Evergreen Analytical Laboratories, Inc. (EAL) in Wheat Ridge, Colorado for analysis (Table 3.1). Sample handling procedures are discussed in Section 3.5.

3.3 TEMPORARY MONITORING POINTS

If conditions prevent use of the Geoprobe® for groundwater and free product sampling as outlined in Section 3.2.2, it may be necessary to collect groundwater and free product samples from temporary monitoring points. Monitoring point installation procedures are presented in this section.

3.3.1 Pre-Placement Activities

All necessary digging, coring, and drilling permits will be obtained prior to mobilizing to the field. In addition, all utility lines will be located, and proposed drilling locations will be cleared prior to any intrusive activities. Responsibilities for these permits and clearances are discussed in Section 3.2.

If possible, water to be used during monitoring point installation (e.g., for equipment cleaning) will be obtained from potable water supplies at the site. Water use approval will be verified by contacting the appropriate facility personnel. The field

scientist will make the final determination as to the suitability of site water for these activities.

3.3.2 Monitoring Point Materials Decontamination

Monitoring point installation and completion materials will be inspected by the field scientist and determined to be clean and acceptable prior to use. If not factory sealed, the well points, casing, and tubing will be cleaned prior to use with a high-pressure, steam/hot-water cleaner using approved water. Materials that cannot be cleaned to the satisfaction of the field scientist will not be used.

3.3.3 Installation and Materials

Subsurface conditions permitting, temporary monitoring points constructed of either 0.75-inch outside-diameter (OD)/0.5-inch inside-diameter (ID), or 1-inch OD/0.75-inch ID, PVC casing and well screen may be used for groundwater and free product sampling if the procedures outlined in Section 3.2 are not possible. For each monitoring point, approximately 5 feet of factory-slotted screen will be installed in the borehole punched for soil sampling using the Geoprobe®.

Prior to installation, it will be necessary to advance the Geoprobe® borehole approximately 4 feet below the water table. A macro-core pre-probe (2-inch-OD drive point or larger) or soil sampler may be used for borehole advancement. Installation of temporary monitoring points requires that the borehole remain open after the borehole is punched below the water table and the rods are withdrawn. Upon removing the rods, the borehole depth will be measured to determine if the hole remains open. If the borehole is open, the PVC casing and screen will be placed so that at least 3 feet of screen is below the water table. The annular space around the screen will be filled with sand filter pack. No grout or bentonite will be placed within the annular space as the monitoring point will be removed upon completion of sampling. Monitoring point construction details will be noted in the site field notes. This information will become part of the field records for the site.

Monitoring point screens will be constructed of Schedule 40 PVC with either an ID of 0.5 inch or 0.75 inch depending on site conditions. The screens will be factory slotted with 0.01-inch openings. Monitoring point screens will be placed to sample both groundwater and free product. Blank monitoring point casing will be constructed of Schedule 40 PVC with an ID of 0.5 or 0.75 inch. All monitoring point casing sections will be flush-threaded; joints will not be glued. The casing at each monitoring point will be fitted with a bottom cap and a top cap constructed of PVC.

If subsurface conditions do not permit the boreholes to stay open (i.e., if the formation collapses in the hole), groundwater and free product samples will be collected from site monitoring wells in accordance with procedures outlined in Section 3.4. The decision to install 0.5-inch-ID PVC monitoring points will be made in the field once the open-hole stability of subsurface soils and availability of Geoprobe® equipment can be evaluated.

3.4 WELL AND MONITORING POINT SAMPLING PROCEDURES

If free product and groundwater cannot be sampled in accordance with the general procedures outlined in Section 3.2, samples will be collected from temporarily installed monitoring points if possible (Section 3.3). If monitoring point installation is not feasible, free product and groundwater samples will be collected from site monitoring wells that contain free product.

The following paragraphs present the procedures to be followed for free product and groundwater sample collection from groundwater monitoring wells and monitoring points. These activities will be performed in the order presented below. Exceptions to this procedure will be noted in the field scientist's field notebook or on the groundwater and free product sampling record (Figure 3.4).

Special care will be taken to prevent cross-contamination of the free product and groundwater samples. The primary way in which sample contamination can occur are through cross-contamination due to insufficient cleaning of equipment between wells and monitoring points. To prevent such contamination, the oil/water interface probe and cable used to determine static water levels and free product thicknesses will be thoroughly cleaned before and after field use and between uses at different sampling locations according to the procedures presented in Section 3.7. Dedicated tubing will be used at each well or monitoring point developed, purged, and/or sampled with the sampling pump. Pumps and nondisposable bailers will be decontaminated according to procedures listed in Section 3.7. In addition to the use of properly cleaned equipment, a clean pair of new, disposable nitrile or latex gloves will be worn by the sampling personnel each time a different well or monitoring point is sampled.

3.4.1 Preparation of Location

Prior to starting the sampling procedure, the area around the existing wells and new monitoring points will be cleared of foreign materials, such as brush, rocks, and debris. These procedures will prevent sampling equipment from inadvertently contacting debris around the monitoring well/point.

3.4.2 Monitoring Well/Point Purging

After sampling free product and prior to sampling groundwater in monitoring points or monitoring wells, it will be necessary to purge the groundwater present in the casing. The volume of water contained within the monitoring well/point casing at the time of sampling will be calculated, and at least three times the calculated volume will be removed from the well/point. One casing volume of free product will be purged prior to sampling. A peristaltic pump will be used for monitoring well and monitoring point purging, depth and volume permitting, and a Grundfos Redi-Flo II® pump,

GROUNDWATER AND FREE PRODUCT SAMPLING RECORD

Job Number 729691.35730
Facility Name ____________________
Site Name ____________________
Sample Location ID ____________________
Sample Date __________

DATE AND TIME OF SAMPLING: __________, 199_ ________ a.m./p.m.
SAMPLE COLLECTED BY: __________ of Parsons ES
(initials)

Check-off

1 GROUNDWATER/FREE PRODUCT COLLECTED FROM
- a [ ] GEOPROBE HOLLOW DRIVE ROD AND PVC ASSEMBLY (ref: Work Plan, Section 3.2)
- b [ ] TEMPORARY MONITORING POINT (ref: Work Plan, Section 3.4)
- c [ ] GROUNDWATER MONITORING WELL __________ (ref: Work Plan, Section 3.4)
  (MW Number)

2 [ ] EQUIPMENT CLEANED BEFORE USE WITH ____________________
Items Cleaned (List): ____________________

3 [ ] PRODUCT DEPTH ____________________ FT. BELOW DATUM
Measured with: ____________________

4 [ ] WATER DEPTH ____________________ FT. BELOW DATUM
Measured with: ____________________

5 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: ____________________
Odor: ____________________
Other Comments: ____________________

6 [ ] WELL EVACUATION:
Method: ____________________
Volume Removed: ____________________
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: ____________________
Other comments: ____________________

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FIGURE 3.4

GROUNDWATER AND FREE PRODUCT SAMPLING RECORD

Fuel Weathering Study

PARSONS ENGINEERING SCIENCE, INC.

Groundwater and Free Product Sampling Record

Sample Location ID. ________________ (Cont'd)

7 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:________________________________

[ ] Pump, type:________________________________

[ ] Other, describe:________________________________

____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

8 [ ] SAMPLE CONTAINERS (material, number, size):________________________________

____

____

____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled

[ ] Container Lids Taped

[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:________________________________

____

____

____

____

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Page 2 of 2

FIGURE 3.4
(CONTINUED)

GROUNDWATER AND FREE PRODUCT SAMPLING RECORD

Fuel Weathering Study

PARSONS ENGINEERING SCIENCE, INC.

Waterra® inertial pump, or bailer will be used to purge all monitoring wells or points in which a peristaltic pump cannot be used. All purge and free product waters will be collected for proper disposal by facility personnel.

If a monitoring well/point is evacuated to a dry state during purging, the monitoring well/point will be allowed to recharge, and the groundwater sample will be collected as soon as sufficient water is present in the monitoring well/point to obtain the necessary sample quantity. Sample compositing or sampling over a lengthy period by accumulating small volumes of water at different times to obtain a sample of sufficient volume will not be allowed.

3.4.3 Free Product and Groundwater Sample Extraction and Analysis

Samples of free product and groundwater will be extracted following the procedures outlined in Section 3.2.2.2.3 and will be analyzed as described in Section 3.2.2.3. However, when a sample is collected from a temporary monitoring point or from a site monitoring well, the free product samples will be collected first, then the groundwater sample will be collected.

3.5 SAMPLE HANDLING FOR LABORATORY ANALYSIS

This section describes the handling of soil, free product, and groundwater samples from the time of sampling until the samples are delivered to either the NRMRL or EAL.

3.5.1 Sample Preservation

NRMRL and EAL will add any necessary chemical preservatives prior to shipment of sample containers to the field for sample collection. After sample collection, samples will be prepared for transportation to the analytical laboratory by placing the samples in a cooler containing ice to maintain a shipping temperature of as close to 4 degrees centigrade (°C) as possible.

3.5.2 Sample Containers and Labels

Free product and groundwater sample containers and appropriate container lids will be provided by the NRMRL and EAL. For samples requiring chemical preservation, preservatives will be added to containers at the laboratory. No containers will be provided for soil sampling unless otherwise specified. After soil sample collection, each open end of the clear plastic liner will be covered with Teflon® fabric and tightly capped using vinyl liner end caps. Free product and groundwater sample containers will be filled as described in Section 3.2.2.2.3, and the container lids will be tightly closed. A sample label will be firmly attached to the container side or plastic liner, and the following information will be legibly and indelibly written on the label:

- Facility name;
- Sample identification;

- Sample type (e.g., groundwater, soil, free product);
- Sampling date;
- Sampling time;
- Analyses requested.

3.5.3 Sample Shipment

After the samples are sealed and labeled, they will be packaged for transport to NRMRL or Evergreen Analytical as appropriate. Delivery will occur as soon as possible after sample acquisition. The following packaging and labeling procedures will be followed:

- Package sample so that it will not leak, spill, or vaporize from its container;
- Cushion samples to avoid breakage; and
- Add ice to container to keep samples cool.

3.5.4 Chain-of-Custody Control

Blank chain-of-custody forms to accompany sample shipments will be provided with sample containers sent to the field by NRMRL and EAL. Chain-of-custody documentation completed by the Parsons ES field personnel will accompany packaged samples to be sent for laboratory analysis.

3.5.5 Sampling Records

In order to provide complete documentation of the sampling event, detailed records will be maintained by the field scientist. At a minimum, these records will include the following information:

- Sample location (facility name);
- Sample identification;
- Sample location map or detailed sketch;
- Date and time of sampling;
- Sampling method;
- Field observations of:
  - Sample appearance, and
  - Sample odor;

- Free product thickness before and after purging;
- Water level before and after purging;
- Purge volume;
- Sample depth (soil samples, only);
- Monitoring well/point condition (free product and groundwater samples);
- Sampler's identification;
- Any other relevant information.

Sampling information will be recorded on forms similar to those shown on Figures 3.2 and 3.4, and in the site field notes.

3.6 SITE RESTORATION

After sampling is complete, each sampling location will be restored as closely to its original condition as possible. Holes created by the Geoprobe® in sandy soils tend to cave in soon after extraction of the drive sampler. However, any test holes remaining open after extraction of the drive rod will be sealed with bentonite chips, pellets, or grout to eliminate any creation or enhancement of contaminant migration pathways to the groundwater.

Soil sampling using the Geoprobe® creates low volumes of soil waste. With the approval of facility personnel, soil not retained as samples will be returned to the open boreholes prior to sealing with bentonite. Methods of waste soil disposal will conform to IDW procedures provided by the facility.

If a temporary monitoring point is used for free product and groundwater sampling, the monitoring point will be abandoned following sample collection. The PVC casing and screen will be extracted as far as possible and discarded. Any test holes remaining open after extraction of the casing will be sealed with bentonite chips, pellets, or grout to eliminate any creation or enhancement of contaminant migration pathways to the groundwater. After monitoring point abandonment, each site will be restored as closely as possible to its original condition.

3.7 DECONTAMINATION PROCEDURES

Prior to arriving at the site, and between each sampling location, probe rods, tips, sleeves, pushrods, samplers, tools, and other downhole equipment will be decontaminated using a high-pressure, steam/hot water wash. Only potable water will be used for decontamination.

All portions of sampling and test equipment that will contact the sample matrix will be thoroughly cleaned before each use. This includes the Geoprobe® sampling tools, sampling pumps, nondisposable bailers, water level probe and cable, test equipment for

onsite use, and other equipment or portions thereof that will contact the samples. Given the types of sample analyses to be conducted, the following cleaning protocol will be used:

- Wash with potable water and phosphate-free laboratory detergent (HP-II detergent solutions, as appropriate);
- Rinse with potable water;
- Rinse with isopropyl alcohol;
- Rinse with distilled or deionized water; and
- Air dry.

Any deviations from these procedures will be documented in the field scientist's field notebook and on the groundwater and free product sampling record (Figure 3.4).

If precleaned, disposable sampling equipment is used, the cleaning protocol specified above will not be required. Laboratory-supplied sample containers will be cleaned and sealed by the laboratory.

Potable water to be used during equipment cleaning, decontamination, or grouting will be obtained from one of the facility's potable water supplies. Water use approval will be verified by contacting the appropriate facility personnel. The field scientist will make the final determination as to the suitability of site water for these activities.

All rinseate will be collected for transportation and proper disposal by facility personnel. Alternate methods of rinseate disposal will be considered by the Parsons ES field scientist as recommended by facility personnel. Precautions will be taken to minimize any impact to the surrounding area that might result from decontamination operations.

SECTION 4

QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC procedures will include collection of field duplicates and trip blanks; decontamination of all equipment that contacts the sample medium before and after each use (Section 3.7); use of analyte-appropriate containers; and chain-of-custody procedures for sample handling and tracking (Section 3.6). All samples to be transferred to either NRMRL or EAL for analysis will be clearly labeled to indicate sample number, location, matrix (e.g., groundwater), and analyses requested. Samples will be preserved in accordance with the analytical methods to be used, and sample containers will be packaged in coolers with ice to maintain a temperature of as close to 4°C as possible.

All field sampling activities will be recorded in a bound, sequentially paginated field notebook or on the appropriate sample form (Figures 3.2 and 3.4) in permanent ink. All sample collection entries will include the date, time, sample locations and numbers, notations of field observations (e.g., odors, UV and OVM readings), and the sampler's name and signature. Field QC samples will be collected in accordance with the program described below, and as summarized in Table 4.1.

QA/QC sampling will include collection and analysis of duplicate free product and groundwater samples and replicate soil samples, trip blanks, and matrix spike samples. Internal laboratory QC analyses will involve the analysis of laboratory control samples (LCSs) and laboratory method blanks (LMBs). QA/QC objectives for each of these samples, blanks, and spikes are described below.

Duplicate free product and water and replicate soil samples will be collected at a frequency of one sample for every five sites sampled (i.e., for every 10 soil, free product, and groundwater samples shipped to NRMRL or EAL). Soil, free product, and groundwater samples collected with the Geoprobe® should provide sufficient volume for replicate/duplicate analyses.

A trip blank will be analyzed to assess the effects of ambient conditions on sampling results during the transportation of samples. The trip blank will be prepared by the laboratory. A trip blank will be transported inside each cooler that contains samples for VOC analysis. Trip blanks will be analyzed for VOCs.

TABLE 4.1
QA/QC SAMPLING PROGRAM
Fuel Weathering Study

QA/QC Sample Types	Frequency to be Collected and/or Analyzed	Analytical Methods
Duplicates/Replicates	1 soil, groundwater, and free product sample every 5 sites	Volatile Organic Compounds (VOCs)
Trip Blanks	One per shipping cooler containing VOC samples	VOCs
Matrix Spike Samples	Once per sampling event	VOCs
Laboratory Control Sample	Once per method per medium	Laboratory Control Charts (Method Specific)
Laboratory Method Blanks	Once per method per medium	Laboratory Control Charts (Method Specific)

Matrix spikes will be prepared in the laboratory and used to establish matrix effects for samples analyzed for VOCs. LCSs and LMBs will be prepared internally by the laboratory and will be analyzed each day samples from the project are analyzed. Samples will be reanalyzed in cases where the LCS or LMB are out of the control limits. Control charts for LCSs and LMBs will be developed by the laboratory and monitored for the analytical methods used (see Table 3.1).

SECTION 5

DATA ANALYSIS AND REPORT

Following receipt and compilation of soil, groundwater, and LNAPL analytical results for the selected sites, a variety of data analyses will be performed. As previously stated, the primary objective of this study is to determine an average range of natural weathering rates for mobile LNAPLs. In addition, mobile LNAPL analytical data will be compared with soil analytical data to evaluate the impact of weathering on residual LNAPL contamination in capillary fringe soils. Finally, the degree of contaminant partitioning occurring between the mobile LNAPL and groundwater will be evaluated.

LNAPL weathering will be assessed by evaluating the mass fraction reduction of BTEX in collected LNAPL samples. Analytical results will be compared to typical initial BTEX concentrations in "fresh" fuel products based on literature values, and to available historic data for the sites. Table 5.1 gives mass fraction values for BTEX in fresh gasoline, JP-4 jet fuel, and aviation gasoline. Literature values such as these will be assumed as the initial composition of the fuel prior to their environmental release. Using the date of the product release and an assumed initial BTEX composition, BTEX concentrations in LNAPL samples from the selected sites can be used to determine the degree of weathering (i.e., BTEX mass fraction depletion) that has occurred over a known period of time. It is anticipated that analytical results will provide a range of LNAPL weathering rates requiring some site-specific trend analyses based on ages of the releases, fuel types, and geologic/hydrogeologic conditions. It is anticipated that a range of weathering rates will be determined for releases of specific fuel types that are approximately 0 to 5 years old, 5 to 10 years old, 10 to 20 years old, and older than 20 years. Weathering rates are expected to decrease with the age of the fuel release (i.e., 0- to 5-year rates are expected to be greater than 10- to 20-year rates).

Weathering effects on residual-LNAPL-contaminated soils also will be assessed. The BTEX/TPH ratio in soil and the BTEX/TPH ratio in mobile LNAPL (TPH in LNAPL is 100 percent) will be compared to determine if weathering effects are more significant for capillary fringe soils than for mobile LNAPL. It is anticipated that BTEX/TPH ratios in capillary fringe soils will be lower than mobile LNAPL BTEX mass fractions as a result of increased weathering in soils due to increased biodegradation and possibly increased volatilization. Comparative trend analyses of soil BTEX mass fractions and mobile LNAPL BTEX mass fraction will be performed.

The degree of BTEX partitioning from mobile LNAPL into groundwater will be assessed and compared to bench-scale and theoretical equilibrium conditions. BTEX concentrations in mobile LNAPL and dissolved BTEX concentrations in groundwater, as determined by NRMRL, will be compared to evaluate a site-specific parameter similar to an octanol/water coefficient (K_{ow}). This fuel/water partitioning coefficient (K_{fw}) like the

TABLE 5.1
BTEX CONCENTRATIONS IN FRESH FUELS
Fuel Weathering Study

Constituent	Gasoline				
	87 Octane (percent)	89 Octane (percent)	92 Octane (percent)	JP-4 (percent)	Aviation Gas (percent)
Benzene	3.15	2.51	2.67	1.07	0.13
Toluene	10.59	12.96	13.13	5.64	22.73
Ethylbenzene	2.10	2.13	2.53	2.03	0.11
m- + *p*- Xylenes	7.97	8.61	9.18	6.03	0.20
o-Xylenes	2.90	3.25	3.23	1.72	0.11
Total BTEX	26.71	29.46	30.74	16.49	23.28

Source: Kaplan and Galperin, 1996.

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octanol/water coefficient provides a measure of how an organic compound (fuel) will partition between oily and aqueous phases, and gives useful information for estimating chemical fate and transport. The fuel/water partitioning coefficient is a dimensionless constant defined by:

$$K_{fw} = C_f/C_w$$

C_f = contaminant concentration in fuel (mg/L or µg/L)

C_w = contaminant concentration in water (mg/L or µg/L)

The K_{fw} determined from mobile LNAPL and groundwater sample results will be considered a "field" K_{fw}. Some emulsification of mobile LNAPL with underlying groundwater is likely to occur during sample collection activities, and as a result, the field K_{fw} determined from NRMRL sample results may not represent equilibrium conditions. To simulate equilibrium conditions, a separate bench-scale determination of the fuel/water partitioning coefficient will be performed.

The bench-scale testing will be performed by EAL using the duplicate mobile LNAPL samples collected from each sampling location. The mobile LNAPL samples will be mixed with distilled water in a VOA bottle, inverted, and placed in a laboratory rack motionless for approximately 2 weeks. After 2 weeks, a sample of the water will be removed from the bottom of the VOA bottle, and a sample of LNAPL will be removed from the top of the bottle, and analyzed for BTEX by USEPA Method E602, and SW8020, respectively. Dissolved BTEX concentrations in the water will be compared to mobile LNAPL concentrations to determine a "bench-scale" K_{fw} for each sampling location. The field and bench-scale K_{fw}'s will be compared and evaluated for each site.

Lastly, BTEX partitioning from the mobile LNAPL to groundwater will be compared with theoretical partitioning according to Raoult's law. A study by Cline *et al.* (1991) showed that equilibrium partitioning of BTEX into water from gasoline followed near-ideal behavior, and could be described by Raoult's law. According to Raoult's law, the concentration of a gasoline constituent in the aqueous phase (C_i) is equal to the mole fraction of the constituent i in the gasoline (X_i) multiplied by the aqueous solubility of the pure constituent (S_i).

$$C_i = X_i S_i$$

Based on Raoult's law, the amount of constituent that partitions into water is dependent on its mole fraction in the mobile LNAPL, and not on the amount of LNAPL present in the groundwater/soil system.

A report detailing the results of the fuel weathering study will be prepared following completion of the literature search and analysis of soil, groundwater, and LNAPL sample data from the selected sites. The report will include an introduction; a summary of the literature search findings; detailed site descriptions for selected sites, including existing soil, groundwater, and mobile LNAPL chemical data; and results of the trend, weathering, and equilibrium analyses described above.

SECTION 6

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APPENDIX A

FUELS WEATHERING LITERATURE SEARCH DRAFT REFERENCE LIST

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A-2

SITE ADDENDA

2.2.6 Tank Farm C, Marine Corps Air Station, Beaufort, South Carolina

The Marine Corps Air Station (MCAS) in Beaufort, South Carolina is located approximately 60 miles south-southwest of Charleston and 1 mile northwest of the City of Beaufort on the South Carolina coast. Tank Farm C is located on the western side of the MCAS approximately 800 feet east of Highway 21 near the intersection of Reed Avenue and R.C. West Road. The facility consists of two 210,000-gallon cut-and-cover steel tanks, a truck loading and unloading stand, a rail line and a railcar unloading stand. A layout of the site is provided on Figure A.1.

The information below was extracted from the ABB Environmental Services, Inc (ABB, 1993) Draft Final Contamination Assessment (CA) Report for the site. In June 1990, approximately 10,600 gallons of JP-5 aviation fuel was released from the underground storage tank (UST) system at Tank Farm C during fuel transfer operations from the adjacent railcar unloading stand into tanks 401 and 402. The release was confirmed to have occurred from the existing 8-inch fill lines located south of tank 401 when fuel was observed seeping upward to the ground surface directly above these fill lines. Upon discovery of the release, the fuel transfer operation was halted, the leak repaired and the system restarted. Shortly after system restart, a second leak occurred in the line approximately 15 feet west of the initial leak location. The transfer operation was then permanently terminated. In response to the leaks, 13,000 gallons of mixed fuel and water were pumped and recovered from a pit excavation opened to repair the line leaks. Based on information collected during the CA, no other reported releases are known to have occurred at the site.

Tank Farm C is underlain by fine-grained, silty sand to approximately 38 feet below ground surface (bgs). The sand lense forms the surficial or shallow aquifer and the depth to groundwater at the site ranges from approximately 2 to 8 feet bgs. The sand is underlain by a dark-gray to olive-gray clay which has been identified as the regional confining unit or Hawthorne formation. The saturated thickness of the shallow aquifer is approximately 33 feet. Groundwater at the site flows generally to the northwest.

In September 1991, eight 2-inch release detection monitoring wells were installed to approximately 20 feet bgs around tanks 401 and 402 (BFT-401-1 through BFT-401-4 and BFT-402-1 through BFT-402-4). Free product was observed, during installation and development of well BFT-401-3, the well closest to the documented fuel release location (Figure A.1). Since the initial recovery of 13,000 gallons of mixed JP-5 fuel and water, manual bailing and recovery of free product from well BFT-401-3 has been regularly performed by MCAS personnel.

The CA site investigation was conducted by ABB in March and April 1993 and involved the advancement of 74 soil borings (B-1 through B-74) to the water table and the installation of 10 shallow monitoring wells (BFT-TF-9 through BFT-TF-18), one

deep well (BFT-TF-19), and one recovery well (BFT-TF-RW-1). The CA site investigation determined that the primary soil contamination resulting from the 1990 release is at 1-to 3-foot bgs in the area south of the tanks. At this time, the estimated horizontal extent of free product encompassed an area which included wells BFT-401-3 and BFT-401-2.

No remedial activities have been conducted at the site. The US Geological Survey has performed modeling to assess the impact of various remedial alternatives at the site including source excavation with long-term passive bioremediation. However, monitoring of the dissolved and free product plumes has shown that the plumes are stable and not migrating from the site (Araico, 1996).

Proposed sampling locations for the Tank Farm C site are shown on Figure A.1. Water level measurements conducted at the site in August 1996, indicated approximately 1.5 inches of free product within well BFT-401-3; however, free product was not detected at well BFT-401-2. Sampling procedures are outlined in Section 3 of the work plan. South Carolina Department of Health and Environmental Control approval will be obtained prior to conducting intrusive sampling activities.

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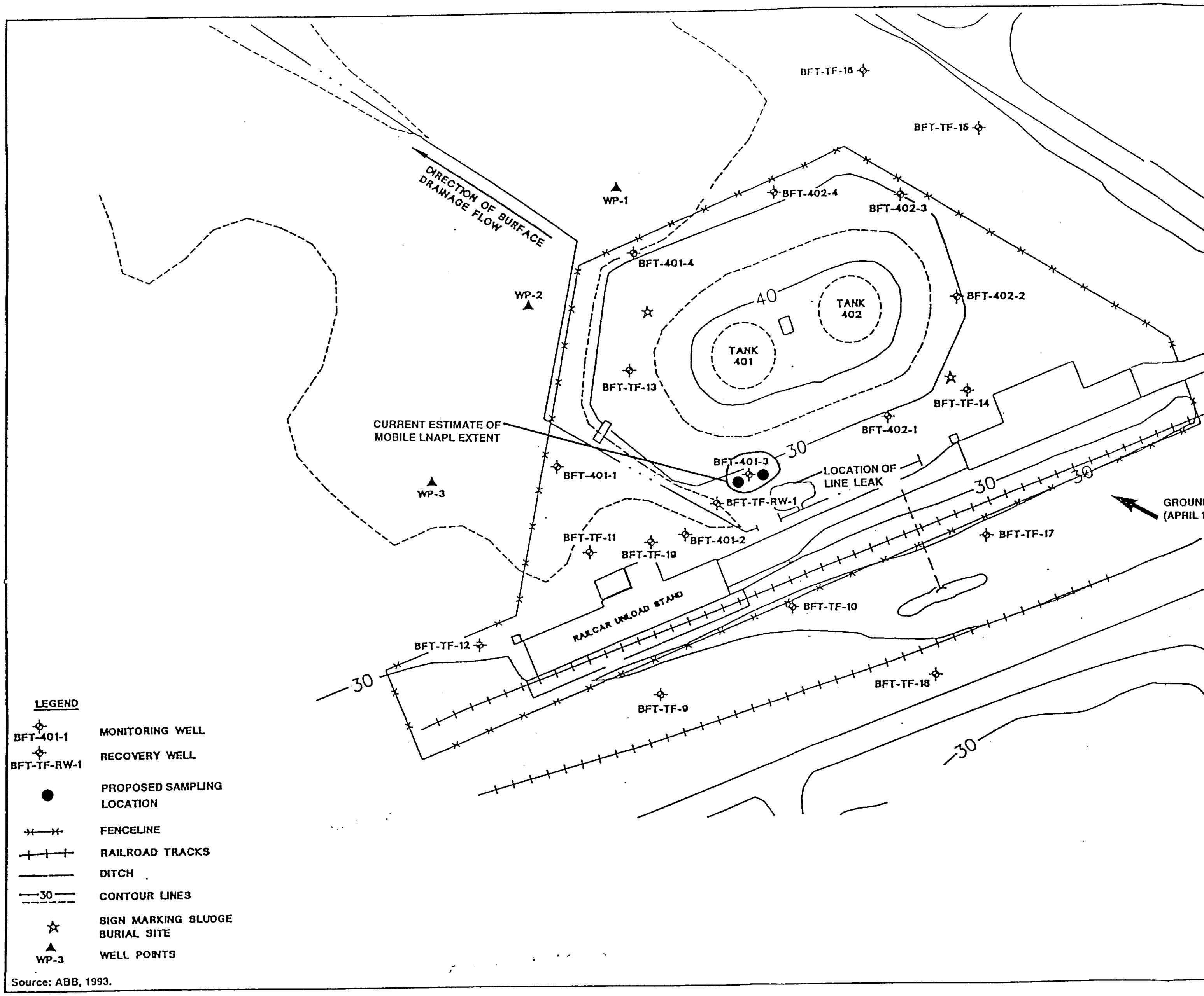

Source: ABB, 1993.

FIGURE A.1

TANK FARM C,
MARINE CORPS AIR STATION,
BEAUFORT, SOUTH CAROLINA
SITE LAYOUT AND
PROPOSED SAMPLING LOCATIONS

Fuel Weathering Study

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

2.2.7 Tank 349 Site, Offutt Air Force Base, Nebraska

Offutt Air Force Base (AFB) is located in eastern Nebraska approximately 4 miles south of Omaha. The Tank 349 site is located in the northern portion of the Base, along Peacekeeper Drive north~~west~~east of Building 301 (Figure A.1). Fuel hydrocarbon-contaminated soil and groundwater at the site and the existence of subsurface free product appears to be the result of long-term leaking from former gasoline underground storage tanks (USTs). The exact date and duration of the release at Tank 349 is not known, but historical LNAPL results from the site are available.

The Tank 349 site is the former location of two 500-gallon gasoline USTs and one 700-gallon diesel UST. Dates of installation for the former USTs are not identified in the site literature. In September 1990, leak verification testing showed one of the gasoline USTs to be leaking. The USTs were taken out of service approximately 1 month prior to verification testing and were never returned to service (Cork, 1997). The two gasoline USTs were excavated in April 1993 and the diesel UST was excavated in September 1993 (Terracon, 1994). During tank removal, 0.25-inch holes were observed in each of the gasoline tanks and in the line connecting the two tanks, but no defects were evident on the diesel tank (Terracon, 1993a; Terracon, 1993b). Contaminated soils were observed during the UST removals; however, soil contamination at the site of the diesel tank excavation appeared to be of little consequence (Terracon, 1993b).

Subsurface soils in the vicinity of the Tank 349 site consist of lean reddish-brown to brown clay overlying interbedded fine to very fine sands, fine to very fine clayey sands, and clays. Occasionally, a trace of sand or gravel was identified in the upper reddish-brown to brown clay. The first distinct sands are encountered near the water table approximately 41 feet below ground surface (bgs) across most of the site. Groundwater depths in the contaminated areas immediately adjacent to Tank 349 have generally varied between 39 and 42 feet bgs. A predominantly easterly groundwater flow direction exists at the site (Parsons Engineering Science [Parsons ES], 1997).

Between December 1993 and March 1994, Terracon installed 14 monitoring wells (MW 349-1 to MW 349-14) and performed soil and groundwater sampling at the Tank 349 site. Field screening of soil samples indicated significant hydrocarbon contamination at wells located northeast and east of the former USTs (MW 349-1, MW 349-2, MW 349-6, MW 349-7, and MW 349-8). During these investigations, free product was measured in MW 349-1, MW 349-2, and MW 349-6, and significant dissolved hydrocarbon contamination was detected in groundwater from MW 349-6, MW 349-7, and MW 349-8.

In 1994, Parsons ES, in conjunction with researchers from the United States Environmental Protection Agency (USEPA) National Risk Management Research Laboratory (NRMRL) was retained by the United States Air Force Center for Environmental Excellence (AFCEE) to conduct site characterization and groundwater modeling to evaluate the scientific defensibility of remediation by natural attenuation (RNA) with long-term monitoring (LTM) as a remedial option for contaminated groundwater at the Tank 349 site. As part of this investigation, Parsons ES performed two phases of site characterization, the first in September and November 1994 and the second in June 1996. The 1994 investigation included performing cone-penetrometer testing (CPT) with laser-induced fluorometry (LIF), sampling and analyzing soils from CPT boreholes, sampling and analyzing groundwater from existing MWs, and measuring and estimating hydrogeologic parameters. In 1996, groundwater elevations were again measured and groundwater quality samples were collected from selected MWs. During each investigation, free product samples also were collected from site MWs and analyzed for benzene, toluene, ethylbenzene, xylenes (BTEX), and other fuel constituents. Free product thicknesses measured during the June 1996 investigation are shown on Figure A.1 and results from the 1994 and 1996 free product sampling events are presented in Table A.1. Other than the tank removal and evaluation of RNA with LTM, no remedial actions have been conducted at the Tank 349 site.

Proposed sampling locations for the Tank 349 site are shown on Figure A.1. Free product measurements conducted at the site in June 1996 ranged from 0.27 feet at MW 349-7 to 2.23 feet at MW 349-6. Due to the depth of the water table at this site, free product and groundwater samples will be collected from existing monitoring wells, rather than from Geoprobe® boreholes. If possible, groundwater and free product samples will be collected from MW 349-1 and MW 349-7 in order to compare with historic free product sample results at these two locations. Sampling procedures are outlined in Section 3 of the work plan. Sampling will be performed in accordance with Offutt AFB and Nebraska Department of Environmental Quality (NDEQ) requirements.

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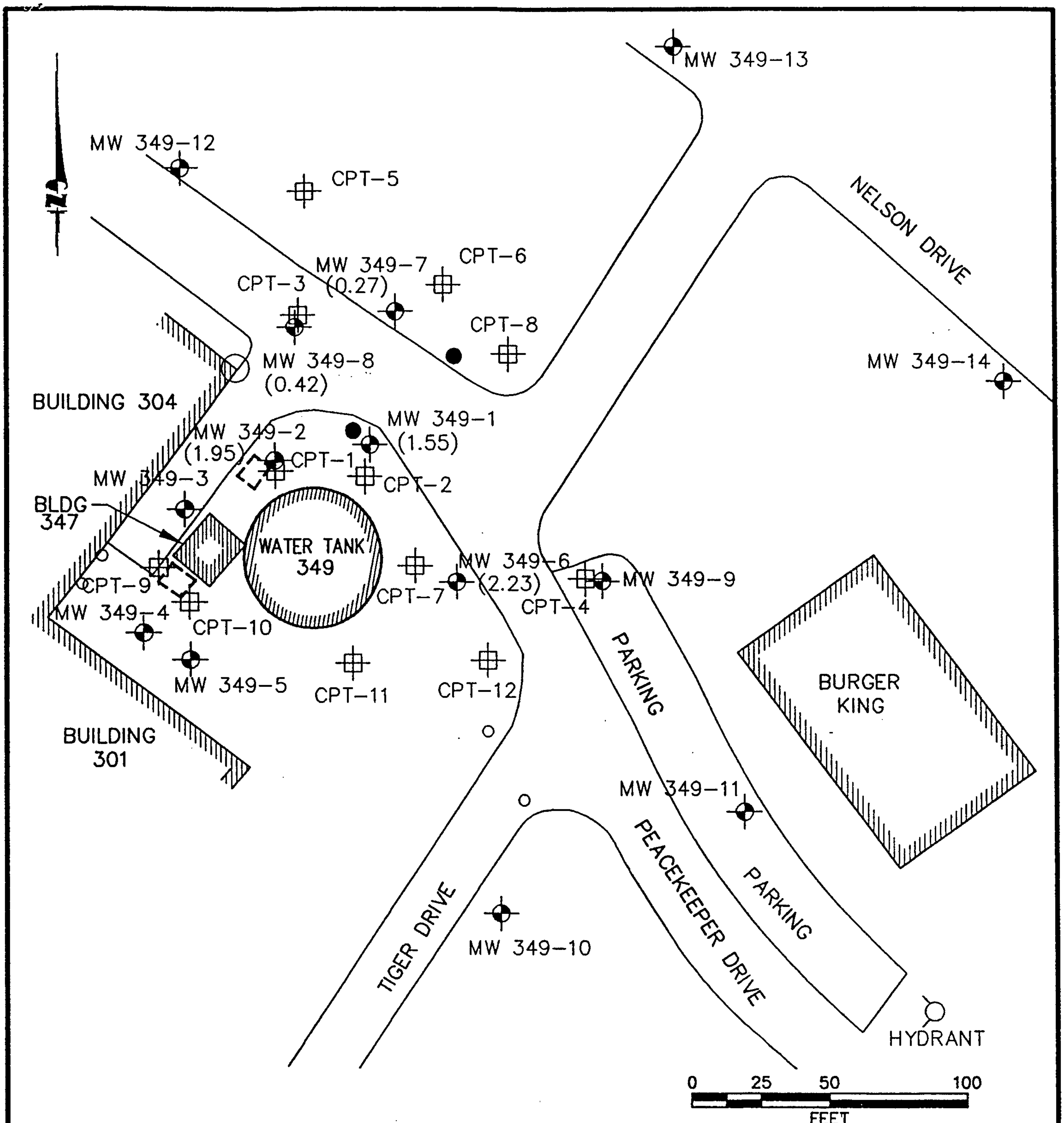

LEGEND

FORMER TANK EXCAVATION

PRE-EXISTING MONITORING WELL

CONE PENETROMETER BOREHOLE

(2.23) JUNE 1996 MEASURED PRODUCT THICKNESS IN FEET

PROPOSED SOIL SAMPLING LOCATION

FIGURE A.1

**TANK 349 SITE,
OFFUTT AFB, NEBRASKA
LAYOUT AND PROPOSED
SAMPLING LOCATIONS**

Fuel Weathering Study

**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

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Table A.1
Summary of Free Product Analysis Results
Tank 349 Site
Offutt AFB, Nebraska

Sample Location	Sample Date	Benzene (mg/L)[b/]	Toluene (mg/L)	Ethylbenzene (mg/L)	p-Xylene (mg/L)	m-Xylene (mg/L)	o-Xylene (mg/L)	Total BTEX[a/] (mg/L)	Total BTEX (% Mass Fraction)[c/]
MW 349-1	Nov-94	8,280	41,100	10,300	8,980	21,700	11,400	101,760	13.90
	Jun-96	8,420	36,400	11,400	9,360	17,700	10,700	93,980	12.84
MW 349-7	Nov-94	5,620	28,600	9,260	8,920	21,400	11,600	85,400	11.67
MW 349-8	Jun-96	955	12,300	10,100	8,030	15,400	9,150	55,935	7.64

[a/] BTEX = benzene, toluene, ethylbenzene, and xylenes.
[b/] mg/L = milligrams per liter.
[c/] Assumes fuel density of 0.7321 grams per milliliter.

2.2.8 Spill Site No. 2, Eaker Air Force Base, Arkansas

Eaker Air Force Base (AFB) is located in northeastern Arkansas approximately 3 miles west of the City of Blytheville and immediately east of the City of Gosnell. Spill Site No. 2 is located in the south-central portion of Eaker AFB at the intersection of South Access Road and Taxiway G (Figure A.1). Fuel hydrocarbon-contaminated soil and groundwater at the site and the existence of subsurface free product appears to be the result of two separate leaks in a 10-inch JP-4 jet fuel pipeline located at the site. The leaks were identified during pressure testing in 1973 and 1974 and according to base personnel a large quantity of fuel was released as a result of the pipeline leaks with little being recovered during pipeline repair activities. No other leaks are known to have occurred at this site; however, the pipeline was not abandoned until 1995 (during base closure activities). The following information was summarized from the Resource Conservation and Recovery Act Facility Investigation (RFI) Report (Haliburton NUS, 1996).

At Spill Site No. 2 the soil profile is composed primarily of a surficial sandy silt loam extending from 1 to 9 feet below ground surface (bgs). Three distinct lithologic units are encountered below the soil profile. The first unit consists of a silty clay that extends to 23 feet bgs. The upper portions of this unit are slightly silty and the lower portions are more sandy. The second unit consists of silt and is first encountered from 9 to more than 25 feet bgs and occurs continuously along the western side of the site. In the central and eastern portions of the site this unit appears as lenses between the clay and underlying sand. The third unit is sand and is first encountered from 8.5 to 37 feet bgs.

The lithology described above encompasses two separate hydrogeologic units. The silts and clays represent an aquitard, and the underlying sand unit is classified as the aquifer. Seepage velocity in the aquitard and aquifer has estimated at 59 feet per year (ft/yr) and 16 ft/yr, respectively. These seepage velocities reflect the lithology and gradients of the two hydrogeologic units. The low seepage velocity in the aquifer is the result of a low aquifer gradient combined with the presence of a poorly sorted sand that contains a significant amount of silt and clay.

During previous investigations at the site several monitoring wells have been installed. In 1988, Halliburton NUS installed three monitoring wells in the vicinity of the 1973 leak (Figure A.1) and performed soil and groundwater sampling at these three locations. Remedial investigation (RI) fieldwork performed in 1991 and 1992 indicated the fuel spill was much larger than originally believed. As part of the RFI, nine monitoring wells were installed around the perimeter of the site, with one monitoring well (MW312) installed near the original pipeline leak location. Following the discovery of free product in well MW306, four additional monitoring wells (MW314,

MW315, MW316, and MW317) were installed on the northeastern side of the site. The wells were installed to depths of 18 to 40 feet.

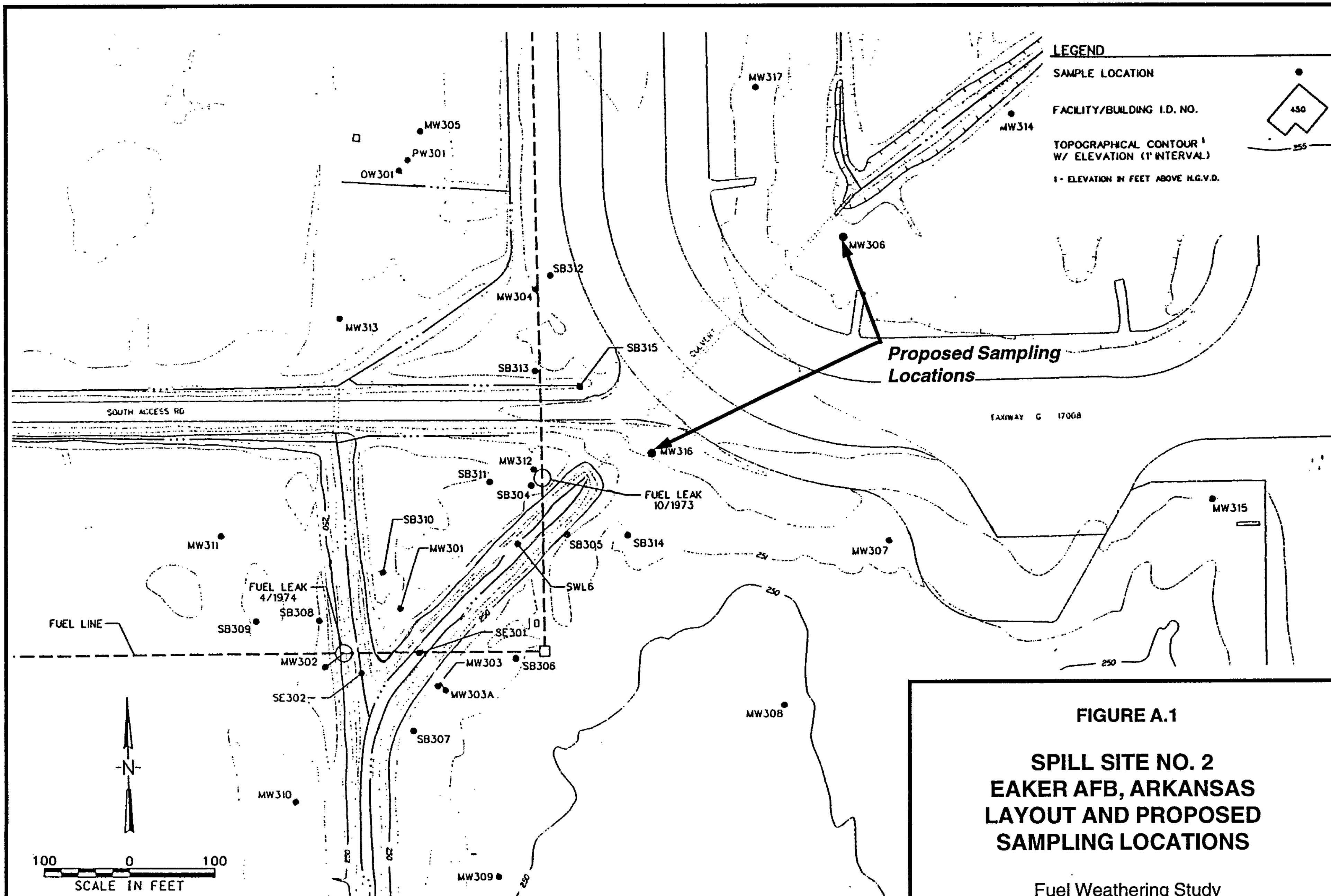
During the RFI, benzene, toluene, ethylbenzene, and xylenes (BTEX) were the most frequently detected petroleum contaminants at the site. With the exception of toluene, the highest concentrations of BTEX compounds (20 milligrams per kilogram [mg/kg], 54 mg/kg, and 300 mg/kg for benzene, ethylbenzene, and total xylenes, respectively) were detected in the MW303 borehole. The highest toluene concentration (0.24 mg/kg) was detected in a sample collected from the MW316 borehole.

The most significant free product thicknesses at the site typically occur in MW306 and MW316. In November 1995, 6.35 and 3.9 feet of free product were reported in each well, respectively. The presence of free product in MW316 is related to the proximity of this well to the original leak location while free product in MW306 is believed to have migrated in a northeasterly direction from the original pipeline leak location along the trace of the existing culvert.

Proposed sampling locations for Spill Site No. 2 are shown on Figure A.1. Free product at the site will most likely be collected from existing monitoring wells MW306 and MW316. In the event sufficient free product for laboratory analysis cannot be collected from these two monitoring wells, other site monitoring wells will be investigated for free product and may be sampled if appropriate. Soil and groundwater samples from this site will be collected from newly installed Geoprobe® boreholes to be placed within 5 to 7 feet of the two wells from which free product sampling is performed. Sampling procedures are outlined in Section 3 of the work plan. Sampling will be performed in accordance with Eaker AFB requirements.

REFERENCES

Haliburton NUS, 1996. RCRA Facility Investigation Final Report, Eaker Air Force Base, Arkansas. Oak Ridge, Tennessee. May.



Source: Haliburton NUS, 1996.

FIGURE A.1

SPILL SITE NO. 2
EAKER AFB, ARKANSAS
LAYOUT AND PROPOSED
SAMPLING LOCATIONS

Fuel Weathering Study

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

2.2.9 Building 4522, Seymour Johnson Air Force Base, North Carolina

The following discussion of the Building 4522 Site at Seymour Johnson Air Force Base (AFB), North Carolina was summarized from the Comprehensive Site Assessment performed by Parsons Engineering Science, Inc. (Parsons ES, 1996) and a conversation with the AFB point of contact for the site (Chastain, 1997).

Seymour Johnson AFB is located south of State Highway 70 in central Wayne County, just south of Goldsboro. On December 14, 1995, the Seymour Johnson AFB Fire Department was notified of a release of JP-8 aviation fuel from a valve pit located approximately 130 feet west of Building 4522 and 350 feet east of Taxiway F (see Figure A.1). The release was attributed to an ineffective "O"-ring seated within a flexible coupling inside the valve pit. By the time the fire department responded to the release, the valve pit, as well as a 90-foot by 35-foot area of grass surrounding the pit, was flooded with fuel. As part of the abatement measures, a trench was dug between the valve pit and a storm water drain located about 90 feet to the west. The trench was used as a sump, and a pump was used to recover approximately 2,200 gallons of the estimated 5,000 gallons of released fuel (Parsons ES, 1996).

The site geology includes a mix of unconsolidated deposits. Brown to light gray fine to medium sand generally occurs from ground surface to approximately 8 to 12 feet below ground surface (bgs). Interfingered layers of a dark gray clay and fine to medium sand underlie the surficial sands to a depth of approximately 40 feet bgs. A dark gray clay appears to be present below the clay/sand layer and extends to at least 47 feet bgs. Depth to groundwater ranges from 3.7 to 8.6 feet across the site, with flow to the west-northwest away from Building 4522 toward Taxiway F (Parsons ES, 1996).

On January 18, 1996, Contractors and Engineers Services, Inc. of Goldsboro, NC installed a shallow monitoring well to determine if groundwater at the site had been impacted by the release. The concentration of groundwater contaminants found in the temporary well were as follows: benzene (2,503 micrograms per liter [μg/L]), toluene (2,060 μg/L), ethylbenzene (1,097 μg/L), xylenes (5,792 μg/L) (BTEX), and lead (91.7 μg/L). Results of a soil sample collected at 5.5 feet bgs in the source area indicated a total petroleum hydrocarbon (TPH) concentration of 5,505 milligrams per kilogram (mg/kg) (Parsons ES, 1996).

In April 1996, Parsons ES performed a Comprehensive Site Assessment to determine the extent of soil and groundwater contamination resulting from the fuel release. As part of the site assessment, Parsons ES performed soil sampling in the vicinity of the release and at boreholes being advanced for monitoring well placement. Soil screening performed using a photoionization detector (PID) identified volatile concentrations in soil headspace samples ranging from nondetect (ND) to 1,356 parts per million, volume per volume (ppmv). Laboratory analytical results from a soil

sample collected approximately 200 feet downgradient of the release indicated a TPH concentration (in the diesel/kerosene fraction) of 511 mg/kg. The remaining three soil samples collected in the vicinity of the spill area showed no detectable TPH concentrations.

Six groundwater monitoring wells (MW-1S, MW-1D, and MW-2 through MW-5) were installed by Parsons ES in April 1996 and groundwater samples were collected from the new wells following completion and development. The source area monitoring well, MW-1S, was not sampled due to the presence of free product. Approximately 2.8 feet of free product was measured at MW-1S during the April 1996 sampling event. BTEX and naphthalene concentrations of 1,400 μg/L, 3,700 μg/L, 730 μg/L, 2,900 μg/L, and 120 μg/L, respectively, were detected in a groundwater sample from MW-4, located approximately 180 feet downgradient of the valve pit. Ethylbenzene, xylenes, and naphthalene were found in relative concentrations of 23 μg/L, 55 μg/L, and 13 μg/L at MW-3, located approximately 150 feet southwest of the valve pit. A groundwater sample collected from MW-1D was used to assess the vertical extent of contamination. No petroleum hydrocarbon contamination was detected in MW-1D, which is screened 31 to 41 feet bgs. Petroleum hydrocarbon concentrations were not detected above the method detection limits in any of the other MWs located at the site.

Further site assessment activities were completed in July 1996, when the US Army Corps of Engineers (USACE), Kansas City District, installed and sampled three additional MWs (MW-6, MW-7, and MW-8) to fully delineate the hydrocarbon plume in groundwater. Benzene and naphthalene were detected in groundwater from MW-6 at concentrations of 460 μg/L and 12 μg/L, respectively; toluene, ethylbenzene, and xylenes were not detected. BTEX and naphthalene concentrations at MW-7 and MW-8 were measured at nondetect or near nondetect levels. During the July 1996 sampling effort, USACE personnel also collected a groundwater sample and a free product sample at MW-1S. BTEX concentrations of 210 μg/L, 799 μg/L, 417 μg/L and 2,486 μg/L, respectively, were detected in the groundwater sample. In the free product sample, relative BTEX concentrations of 246 mg/L, 1,631 mg/L, 1,239 mg/L, and 7,527 mg/L were detected.

Other than the occasional bailing of MW-1S and the initial fuel recovery from the trench, no remedial activities have been performed at the Building 4522 spill site (Chastain, 1997). Based on this condition, and compliance with other site selection criteria (reference October 1996 Work Plan, Section 2.1) the Building 4522 spill site represents a good candidate site for the fuel weathering study.

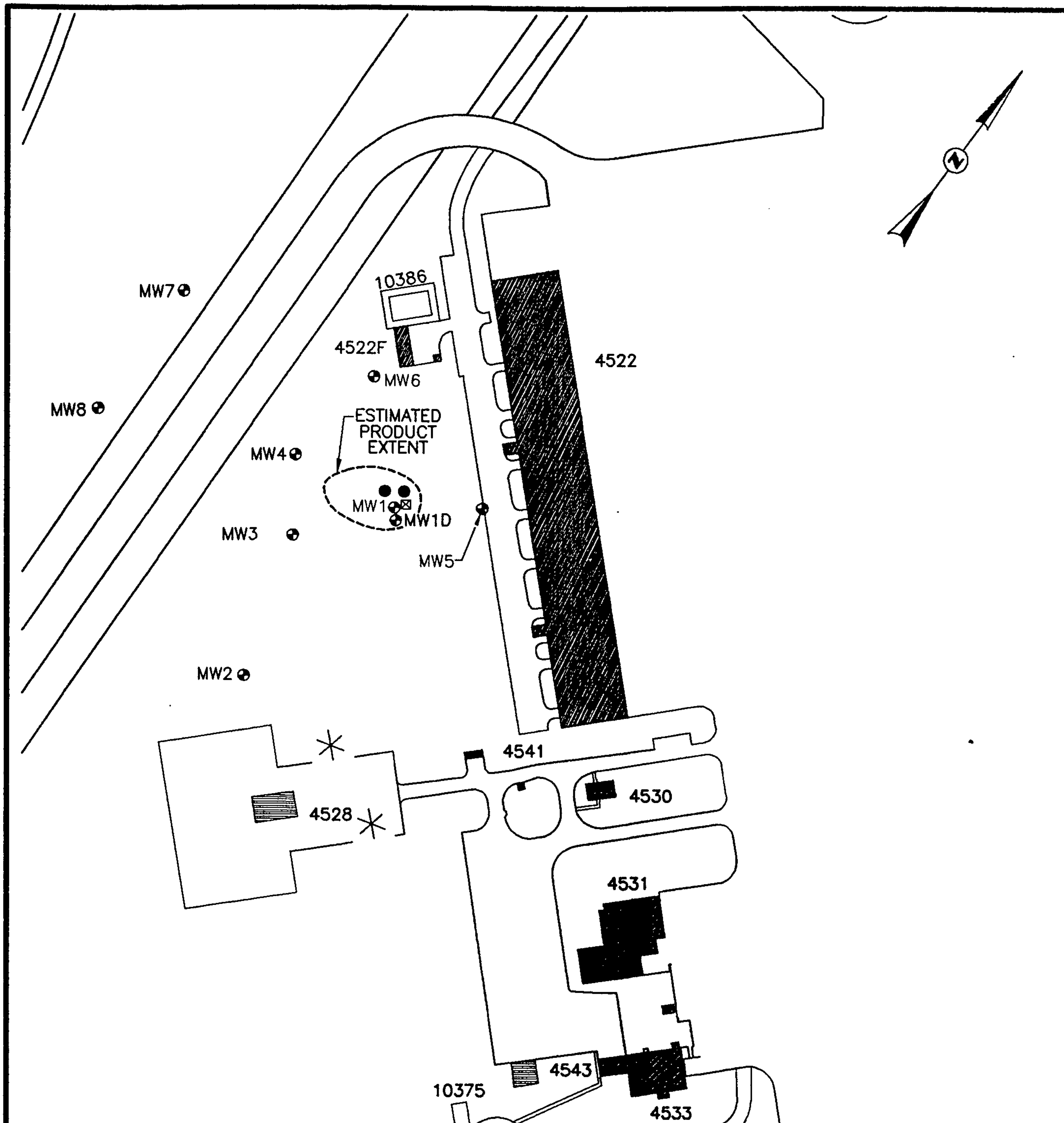
Proposed sampling locations for the Building 4522 Site are shown on Figure A.1. If possible, soil, groundwater, and free product sampling will be performed using boreholes and temporary monitoring points installed using a Geoprobe®. Specific

sampling procedures are outlined in Section 3 of the work plan and will be performed in accordance with Seymour Johnson AFB requirements.

REFERENCES

Chastain, Dean. 1997. 4th CES/CEV, Seymour Johnson Air Force Base, North Carolina. Telephone Conversation. January 24.

Parsons ES. 1996. Final Comprehensive Site Assessment of Building 4522, Seymour Johnson Air Force Base, North Carolina. Cary. July.



LEGEND

- MONITORING WELL (MW)
- VALVE PIT
- PROPOSED SAMPLING LOCATION

200' 100' 0 200'

Approximate Scale in Feet

SOURCE: PARSONS ES, 1996

FIGURE A.1

BUILDING 4522, SEYMOUR JOHNSON AFB, NORTH CAROLINA SITE LAYOUT AND PROPOSED SAMPLING LOCATIONS

Fuel Weathering Study

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

K:\TEMP\SJ039.DWG

APPENDIX B

SAMPLE ANALYTICAL DATA

B-1

NRMRL DATA

MANTECH

Ref: 96JAD49

September 3, 1996

Wurtsmith

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Don:

As requested in Service Request # SF-2-231, headspace GC/MS analysis of 3 Wurtsmith water samples for BTEXXXTMB was completed. The samples were received on August 8, 1996 and analyzed on August 26, 1996. RSKSOP-158 (Determination of Volatile Aromatic Compounds and Tert-Butylmethylether in Water by Automated Headspace Gas Chromatography/Mass Spectrometry (Saturn II Ion Trap Detector) was used for this analysis.

An internal standard calibration method was established for the 9 compounds. The standard curves were prepared from 1.0 to 4000 ppb. The lower calibration limits were 1.0 ppb.

A quantitation report for the samples, lab duplicates, field duplicates, QC standards and lab blanks is presented in table 1.

If you should have any questions, please feel free to contact me.

Sincerely,

John Allen Daniel

John Allen Daniel

xc: R.L. Cosby
G.B. Smith
D.D. Fine
J.L. Seeley
J.T. Wilson

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

Table 1. Quantitation Report for S.R. # SF−2−231 from Wurtsmith.

Concentration = ppb

Compound	5B4	5B4 Lab Dup	5B5	5B5 Field Dup 1/5 Dil	TRIP BLANK	QC0826A 20 PPB	QC0826B 200 PPB	BL0826A
Benzene	ND	ND	ND	ND	ND	21.0	205	ND
Toluene	---	---	*****	6560	---	19.9	196	ND
Ethylbenzene	ND	ND	179	188	ND	20.3	206	ND
p−Xylene	---	ND	610	553	---	19.3	191	ND
m−Xylene	---	---	1210	1160	---	19.3	193	ND
o−Xylene	ND	ND	1390	1220	ND	20.7	209	ND
1,3,5−Trimethylbenzene	22.4	24.0	251	201	ND	19.8	197	ND
1,2,4−Trimethylbenzene	1.2	1.1	630	547	---	19.5	199	---
1,2,3−Trimethylbenzene	49.2	50.4	477	371	---	20.4	211	---

ND = None Detected   ***** = Above Calibration Limit(4000 ppb)   --- = Below Calibration Limit(1.0 ppb)   QC = Quality Control Std.   BL = Blank   Dil = Dilution

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 96-DF55

Aug. 20, 1996

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Don:

As requested in Service Request SF-2-231, GC/MS analysis for extractable polyaromatic hydrocarbons and BTEXXXBTM was done on two soil samples from Wurtsmith AFB. Soxhlet extraction and concentration of the soil samples were completed on Aug. 12, 1996. The GC/MS analysis of the samples completed on Aug. 18, 1996. EPA method 8270A with the modifications listed below was used for this analysis.

The soil extracts were prepared by Mark Blankenship according to his standard operating procedure for Soxhlet extraction of soil samples which is based on EPA Method 3540A. A sample weight of 5 grams was extracted using 200 ml of GC/MS grade methylene chloride in a Soxhlet apparatus. The extract was dried using Na_2SO_4 and was then concentrated using a Savant Evaporation Station to a final volume of 1.0 ml.

For quantitative analysis, 10.0 μl of a 2000 ppm internal standard mixture of benzene-d_6, toluene-d_8, ethylbenzene-d_{10}, p-xylene-d_{10}, o-xylene-d_{10}, p-dichlorobenzene-d_4, naphthalene-d_8 and acenaphthene-d_{10} in methylene chloride was added to 200 μl of each standard or sample. Calibration curves were prepared from three dilutions of a Supleco P-I-A-N-O mixture containing 140 compounds. The Hewlett Packard 7673 autoinjector delivered 1.0 μl of the methylene chloride extract with a splitless injection to a 60 meter, 0.25 mm DB5-MS capillary column with 0.25 μm film thickness. The column was temperature programmed from -10°C to 60°C at 30°C/min and then to 300°C at 6°C/min. The Finnigan 4615 GC/MS was scanned from 42 to 650 m/z in 0.5 sec.

Attached please find chromatograms of each of the Soxhlet extracts of soil cores. Significant peaks are labeled with the best result from the EPA/NBS library search. The largest peaks in methylene chloride extract of soil cores, SB4 and SB5, were identified as dibutyl phthalates and dioctyl adipate. Sample SB4 contained an aliphatic profile which contained C_{12}, C_{13}, C_{14}, C_{15}, C_{16}

and C_{17} alkanes. The content of dodecane, tridecane, tetradecane and pentadecane was determined to be 1.2, 3.2, 5.1 and 1.8 μg/g of soil core, respectively. These concentrations are corrected for moisture. Toluene was also identified in the core extract and is estimated at 0.2 μg/g. These compounds were not found in the core extract of sample SB5.

If you should have any questions, please feel free to contact me.

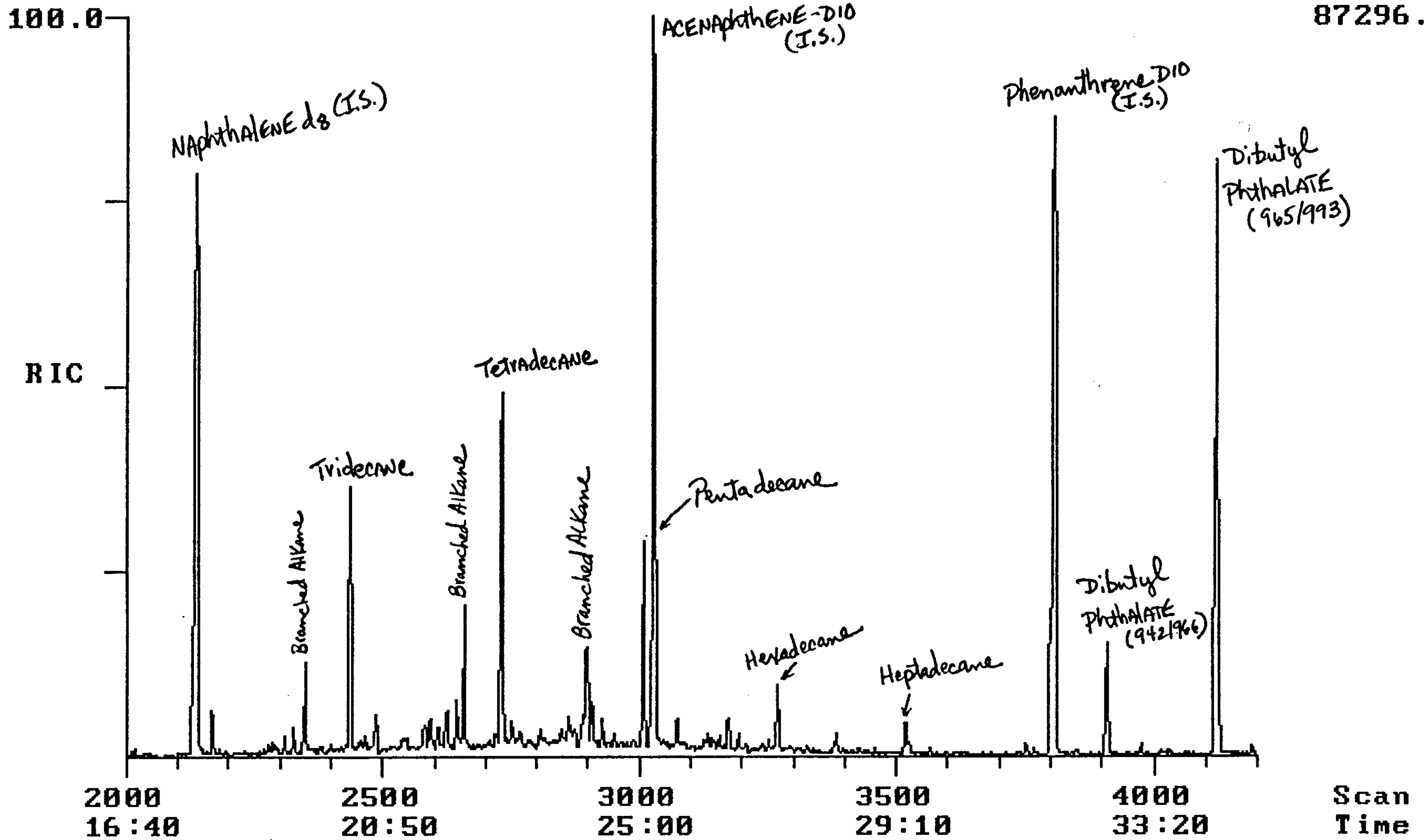
Sincerely,

Dennis D. Fine

Dennis D. Fine

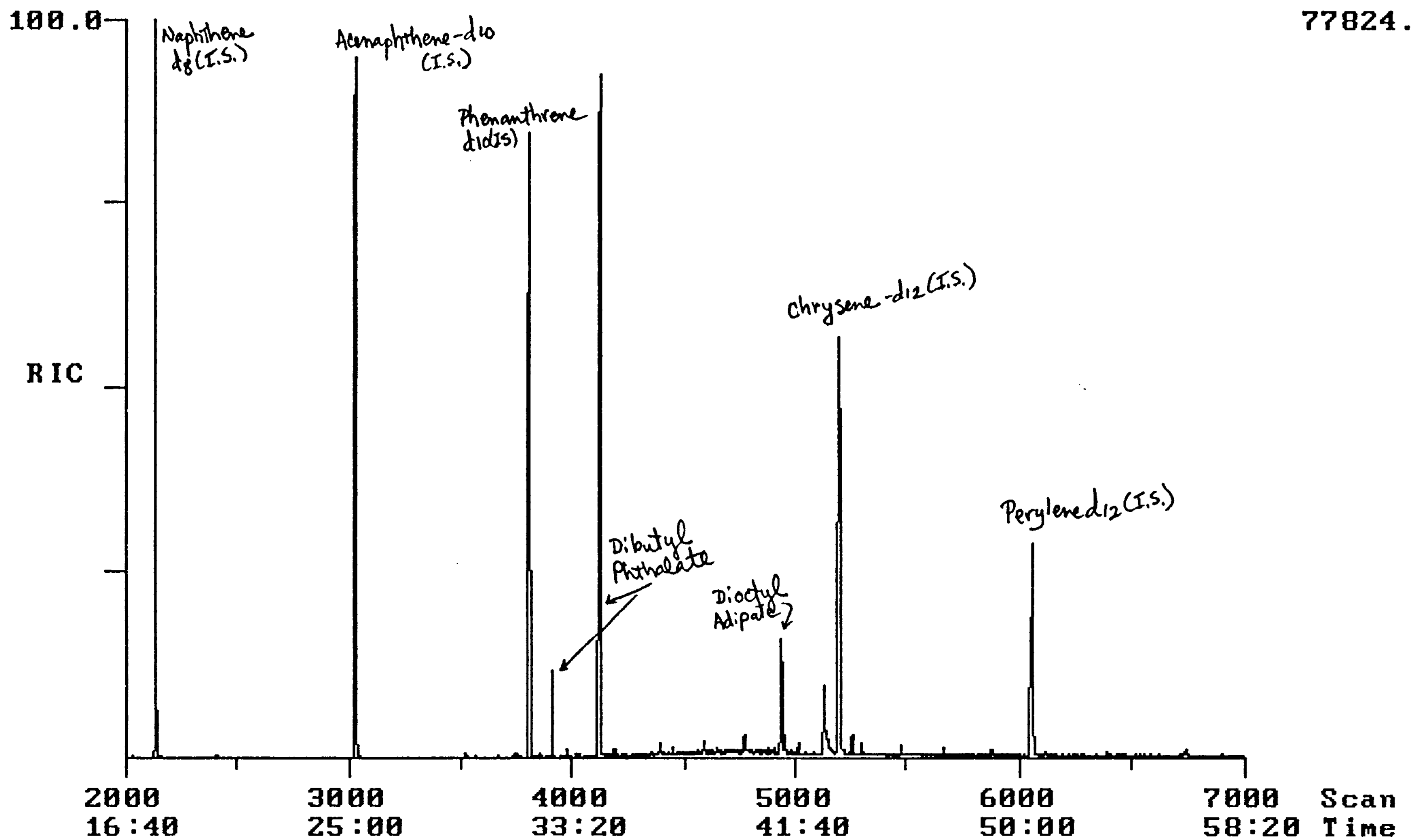
xc: R.L. Cosby (RSKERL)
G.B. Smith
J.L. Seeley

RIC | Data: 15SB4 #3028 | Scans 2000 to 4200
08/18/96 17:02:00 | Cali: 15SB4 #3
Sample: 1UL 200UL MECL2 SOXHLET EXT 5.31G WURTSMITH CORE SB4 + 10UL 2000
Conds.: -10C TO 60C 30C/MIN TO 300C 6C/MIN DB5MS60X.25X.25 SPLITLESS
Range: G 1,7000 Label: N 0, 4.0 Quan: A 0, 1.0 J 0 Base: U 20, 3



CHRO:

RIC   Data: 16SB5 #1   Scans 2000 to 7000
08/18/96 18:20:00   Cali: 16SB5 #3
Sample: 1UL 200UL MECL2 SOXHLET EXT 5.18G WURTSMITH CORE SB5 + 10UL 2000
Conds.: -10C TO 60C 30C/MIN TO 300C 6C/MIN DB5MS60X.25X.25 SPLITLESS
Range: G 1,7000 Label: N 0, 4.0 Quan: A 0, 1.0 J 0 Base: U 20, 3



CHRO:

MANTECH ENVIRONMENTAL TECHNOLOGY

Wurtsmith

Ref: 96-DK45/vg
October 10, 1996

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

Please find attached results of GC/MSD analysis of Wurtsmith AFB core extracts for quantitation of benzene, toluene, ethylbenzene , p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, naphthalene, 2-methylnaphthalene and 1-methylnaphthalene under Service Request #SF-2-231.

The analytical method was a modification of RSKSOP-124. Cool (38°C) on-column injection (0.5 μl) was used with electronic pressure control (EPC) set for a constant flow of 0.9 ml/min. A 30M X 0.25 mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5μm film) capillary GC column with 1 foot long X 0.53 mm ID uncoated capillary precolumn was used. Quantification was based on two standard curves: A low level curve was used for extract concentrations in the range 0.025-2.5 μg/ml (0.025,0.25,2.5 μg/ml). The second curve was used for quantification of concentrations >2.5 (2.5,25,250 μg/ml). Ion 128 was used for quantification of naphthalene and ions 141 + 142 for the methylnaphthalenes. Complete ChemStation method and calibration reports have been recorded. The samples were extracted by Mr. Mark Blankenship on August 12, 1996. I analyzed the samples by GC/MSD on September 7, 1996.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
G.B. Smith
J.L. Seeley SV for
J.T. Wilson

Sample	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene
SB-4 (Soil #2)	ND	ND	ND	ND	ND	ND
SB-5 (Soil #1)	ND	8.55E-02	ND	ND	ND	ND

Sample	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene
SB-4 (Soil #2)	2.80E-01	ND	4.75E-02	ND	1.44E-01	1.17E-01
SB-5 (Soil #1)	3.00E-01	ND	5.14E-02	ND	1.58E-01	1.18E-01

[redacted] AIN [redacted] C [redacted] RE [redacted] RD [redacted] NA [redacted] TIC [redacted] SE [redacted] CE [redacted] RE [redacted] EST [redacted]

Page 1 of 1

EPA Kerr Lab / Ada Oklahoma

~~Evergreen Analytical Inc.~~
~~4036 Youngfield St.~~
~~Wheat Ridge, Colorado 80033~~
~~(303) 425-6021~~
~~FAX (303) 425-6854~~
~~(800) 845-7400~~
~~FAX RESULTS Y / N~~

Attn: Steve Vandegrift

COMPANY Parsons Engineering Science
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208

CLIENT CONTACT (print) Craig Snyder
CLIENT PROJ. I.D. 729691. 35730
EAL. QUOTE # ______ P.O.# ______
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST ☐ Other (Specify)* ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: Oil / Sludge / Multi-phase	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	TMB's						LAB Sample No.
SB5 Wurtsmith Soil #1	8/6/96	10:30	1		X									X							X						
SB4 Wurtsmith Soil #2	8/6/96	10:00	1		X									X							X						
SB5 Wurtsmith water #2	8/6/96	16:30	2	X										X							X						
SB4 Wurtsmith water #1	8/6/96	16:15	2	X										X							X						
Trip Blank			1	X										X							X						
Sample Fraction																											Loc
Instructions: No Product Samples were collected																											Cont

EAL use only
Do not write in shaded area
Project # ______
B.O.F. # ______
Cooler (out) # ______
Cooler (In) # ______
Cooler Temp. °C ______
Seals Intact Y / N / NA
Samples Pres. Y / N / NA

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	8/7/96 0615						

Ref: 96-DK46/vg
October 11, 1996

1996
Soil Samples from
Pope [illegible]

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of methylene chloride extracts of soil samples from Pope AFB for quantitation of selected target compounds (i.e., benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, naphthalene, 2-methylnaphthalene, 1-methylnaphthalene, 2-methylhexane, n-heptane and n-pentadecane). The work was performed under Service Request #SF-2-224.

The analytical method was a modification of RSKSOP-124. Cool (38°C) on-column injection (0.5 µl) was used with electronic pressure control (EPC) set for a constant flow of 0.9 ml/min. A 30M X 0.25 mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) capillary GC column with 1 foot long X 0.53 mm ID uncoated capillary precolumn was used. Quantification was based on two standard curves: A low level curve was used for extract concentrations in the range 0.025-2.5 µg/ml (0.025,0.25,2.5 µg/ml). The second curve was used for quantification of concentrations >2.5 (2.5,25,250 µg/ml). The alkane compounds (2-methylhexane, n-heptane and n-pentadecane) were quantified using the TIC of ions 43, 57, 71 and 85. Ion 128 was used for quantification of naphthalene and ions 141 + 142 for the methylnaphthalenes. Complete ChemStation method and calibration reports have been recorded. The samples were extracted by Mr. Mark Blankenship on July 19, 1996. I analyzed the samples by GC/MSD on September 7-8, 1996.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
G.B. Smith
J.L. Seeley SV for
J.T. Wilson

S.R. SF-2-224 Dr. Kampbell

Soil Extracts from Pope AFB ... GC/MSD

Units = mg/kg

Sample	2-methylhexane	n-heptane	Benzene	Toluene	EB	p-Xylene	m-Xylene	o-Xylene
9 POP2	ND	ND	ND	ND	ND	ND	ND	ND
9 POP2 Duplicate	ND	ND	ND	ND	ND	ND	ND	ND
Near 7 POP2	ND	ND	ND	ND	ND	ND	ND	ND
Soil Sample 2	1.65E+02	2.43E+02	1.11E+01	7.86E+01	6.42E+01	4.57E+01	1.15E+02	7.24E+01
Soil Sample 1	9.36E+01	1.40E+02	1.14E+01	3.25E+01	3.22E+01	2.45E+01	6.89E+01	4.31E+01
Check Standards (ug/ml)								
250	2.45E+02	2.45E+02	2.47E+02	2.41E+02	2.42E+02	2.43E+02	2.38E+02	2.41E+02
250	2.38E+02	2.37E+02	2.39E+02	2.40E+02	2.41E+02	2.44E+02	2.39E+02	2.42E+02
25	2.39E+01	2.41E+01	2.51E+01	2.40E+01	2.47E+01	2.44E+01	2.32E+01	2.39E+01
2.5	2.51E+00	2.52E+00	2.42E+00	2.38E+00	2.14E+00	2.18E+00	2.45E+00	2.31E+00
0.25	2.45E-01	2.45E-01	2.47E-01	2.47E-01	2.41E-01	2.39E-01	2.39E-01	2.48E-01
Method Blank	ND	ND	ND	ND	ND	ND	ND	ND

Sample	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Pentadecane	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene
9 POP2	8.30E-02	1.93E-01	1.36E-01	1.52E+00	1.01E-01	2.71E-01	1.80E-01
9 POP2 Duplicate	9.11E-02	2.19E-01	1.47E-01	1.98E+00	1.15E-01	3.23E-01	2.39E-01
Near 7 POP2	ND	ND	ND	ND	ND	ND	ND
Soil Sample 2	5.06E+01	1.41E+02	5.72E+01	1.06E+02	2.55E+01	4.83E+01	3.34E+01
Soil Sample 1	4.82E+01	1.29E+02	5.64E+01	8.78E+01	2.17E+01	4.20E+01	2.64E+01
Check Standards (ug/ml)							
250	2.45E+02	2.42E+02	2.43E+02	2.44E+02	2.41E+02	2.40E+02	2.40E+02
250	2.39E+02	2.42E+02	2.42E+02	2.36E+02	2.46E+02	2.47E+02	2.44E+02
25	2.29E+01	2.66E+01	2.43E+01	2.11E+01	2.40E+01	2.52E+01	2.43E+01
2.5	2.42E+00	2.44E+00	2.45E+00	2.22E+00	2.47E+00	2.44E+00	2.57E+00
0.25	2.45E-01	2.44E-01	2.50E-01	2.49E-01	2.42E-01	2.41E-01	2.41E-01
Method Blank	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs

BLQ < 0.06 ug/ml

Printed: 10/11/96

MANTECH

Age of weathering project

Ref: 96-DF51

Aug. 12 1996

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Water Samples
Pope & Seymour Johnson
GC/MS

THRU: S.A. Vandegrift SV

Dear Don:

As requested in Service Request SF-2-224, GC/MS analysis for aromatic and semi-volatile compounds was done on four water samples from Pope AFB. These samples were labeled: MW-1S, 7POP2, 9POP2, and MW??. The samples were received on July 15 and 18, 1996. Base/neutral extractions of the water samples were completed on July 16 and 18, 1996. The GC/MS analyses of the sample were completed on July 22 and 23, 1996. EPA method 8270A with the modifications listed below was used for this analysis.

The extracts were prepared by Brad Scroggins according to the standard operating procedure for base/neutral extraction. After the pH of one liter of each water sample was adjusted to slightly above 11.0 with 10N NaOH, the water sample was extracted three times with 60 ml of methylene chloride. After the methylene chloride fraction was passed through a Na_2SO_4 column, it was concentrated using the Turbo-Vap to a final volume near 1.0 ml.

For quantitative analysis, 10.0 μl of a 2000 ppm internal standard mixture of benzene-d_6, toluene-d_8, ethylbenzene-d_{10}, p-xylene-d_{10}, o-xylene-d_{10}, p-dichlorobenzene-d_2, naphthalene-d_8 and acenaphthene-d_{10} in methylene chloride was added to 1 ml of each standard or sample. Calibration curves were prepared from three dilutions of a Supleco P-I-A-N-O mixture containing 140 compounds. The Hewlett Packard 7673 autoinjector delivered 1.0 μl of the methylene chloride extract with a split flow of 20 ml/min to a 60 meter, 0.25 mm DB5-MS capillary column with 0.5 μm film thickness. The column was temperature programmed from -10°C to 60°C at 30°C/min and then to 300°C at 6°C/min. The Finnigan 4615 GC/MS was scanned from 42 to 650 m/z in 0.5 sec.

Table I provides the concentrations of alkanes and aromatic compounds found in the Pope AFB samples. A standard blank, method extraction blank, and check standard of the PIANO mix are included. Chromatograms of each of the four samples are also attached. The individual peaks of sample MW1S are labeled with the best library fit from the NBS library search.

If you should have any questions, please feel free to contact me.

Sincerely,

Dennis D. Fine

Dennis D. Fine

xc: J. Seeley
G. Smith
R. Cosby
D. Fine

Table I. Quantitative Report and QC Data for Aromatic and Aliphatic Compounds from Water Samples from Pope AFB (Service Request SF−2−224)

Pope | Seymour Johnson

		Concentration ppb				Concentration ppb		
		7POP2	9POP2	MW??	MW−1S	Standard Blank	Method Blank	Check Std. Recovery Plano Mix
1	Benzene	N.F.	N.F.	N.F.	210	N.F.	N.F.	99
2	Heptane	N.F.	***	***	***	N.F.	N.F.	90
3	Toluene	***	20	1	799	***	***	112
4	Octane	N.F.	57	4	413	N.F.	N.F.	104
5	Ethylbenzene	7	32	2	417	***	***	104
6	m,p−Xylene	34	157	8	1687	***	***	100
7	o−Xylene	33	95	9	799	***	***	102
8	Nonane	***	25	***	3584	N.F.	N.F.	98
9	Isopropylbenzene	***	12	***	112	N.F.	N.F.	101
10	n−Propylbenzene	5	42	***	239	N.F.	N.F.	103
11	1−Ethyl−3−methylbenzene	42	183	4	954	N.F.	N.F.	91
12	1−Ethyl−4−methylbenzene	10	58	***	278	N.F.	N.F.	100
13	1,3,5−Trimethylbenzene	31	136	3	685	N.F.	N.F.	98
14	1−Ethyl−2−methylbenzene	24	90	4	436	N.F.	N.F.	96
15	t−Butylbenzene	N.F.	***	***	N.F.	N.F.	N.F.	98
16	Decane	22	1039	***	4692	N.F.	N.F.	100
17	1,2,4−Trimethylbenzene	120	456	N.F.	1993	N.F.	***	97
18	Iso−Butylbenzene	4	22	***	82	N.F.	N.F.	100
19	sec−Butylbenzene	***	33	***	125	N.F.	N.F.	95
20	1−Methyl−3−isopropylbenzene	N.F.	52	***	214	N.F.	N.F.	98
21	1,2,3−Trimethylbenzene	75	217	7	852	−−−	−−−	−−−
22	1−Methyl−4−isopropylbenzene	11	61	***	165	N.F.	N.F.	100
23	1−Methyl−2−isopropylbenzene	***	10	***	40	N.F.	N.F.	95
24	1−Methyl−3−n−propylbenzene	20	169	1	527	N.F.	N.F.	98
25	n−Butylbenzene	9	97	***	253	N.F.	N.F.	96
26	1,2−Diethylbenzene	6	31	1	109	N.F.	N.F.	101
27	1−Methyl−2−n−propylbenzene	15	113	2	349	N.F.	N.F.	97
28	1,4−Dimethyl−2−ethylbenzene	16	113	***	336	N.F.	N.F.	96
29	1,2−Dimethyl−4−ethylbenzene	25	163	2	487	N.F.	N.F.	96
30	1,3−Dimethyl−2−ethylbenzene	6	28	***	93	N.F.	N.F.	96
31	Undecane	72	1753	***	5983	N.F.	***	101
32	1,2−Dimethyl−3−ethylbenzene	12	68	1	189	N.F.	N.F.	98
33	1,2,4,5−Tretramethylbenzene	12	82	1	240	N.F.	N.F.	102
34	2−Methylbutylbenzene	***	16	***	***	N.F.	N.F.	100
35	tert−1−Butyl−2−methylbenzene	N.F.	N.F.	N.F.	N.F.	N.F.	N.F.	100
36	Pentylbenzene	5	80	N.F.	114	N.F.	***	101
37	1−tert−Butyl−3,5−dimethylbenzene	***	***	N.F.	N.F.	N.F.	N.F.	100
38	1−tert−Butyl−4−ethylbenzene	N.F.	N.F.	N.F.	N.F.	N.F.	N.F.	100
39	Dodecane	76	1683	2	6040	N.F.	N.F.	99
40	1,3,5−Triethylbenzene	***	***	***	***	N.F.	***	100
41	1,2,4−Triethylbenzene	***	11	***	***	N.F.	***	102
42	Hexylbenzene	5	42	***	111	N.F.	N.F.	100
43	Tridecane	63	1391	***	5495	N.F.	N.F.	92
44	Tetradecane	51	1000	N.F.	4254	N.F.	N.F.	101
45	Pentadecane	14	448	N.F.	1403	N.F.	N.F.	94

*** indicates concentration of extract was below lowest calibration standard (1 ppm).
N.F. indicates not found.
−−− indicates that this compound is not included in calibration mixture.

NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
Subsurface Protection and Remediation Division
(Robert S. Kerr Environmental Research Center)
919 Kerr Research Drive
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1996
Water samples
Pope & Seymour
Johnson by
Headspace
GC/MS

fax transmittal

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date: 9/16/96

pages: , including cover sheet

NOTES: Age of Weathering

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 96JAD51

September 10, 1996

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Don:

As requested in Service Request # SF-2-224, headspace GC/MS analysis of 6 Pope AFB water samples for volatile organics including trimethylbenzenes was completed. The samples were received on July 18, 1996 and analyzed on August 16, 1996. RSKSOP-148 (Determination of Volatile Organic Compounds in Water by Automated Headspace Gas Chromatography/Mass Spectrometry (Saturn II Ion Trap Detector) was used for this analysis.

An internal standard calibration method was established for the 24 compounds. The standard curves were prepared from 1.0 to 4000 ppb. The lower calibration limits were 1.0 ppb.

A dilution corrected quantitation report for the samples, lab duplicates, field duplicates, QC standards and lab blanks is presented in table 1.

If you should have any questions, please feel free to contact me.

Sincerely,

John Allen Daniel

John Allen Daniel

xc: R.L. Cosby
G.B. Smith
D.D. Fine
J.L. Seeley
J.T. Wilson JB

Table 1. Quantitation Report for S.R.# SF-2-224 from Pope AFB.

Seymour Johnson Concentration = ppb Pope AFB

Compound	MW ?? Site 1	MW?? Site 1 Field Dup	* MW-1S Site 1 1/2 Dil	* MW-1S Site 1 1/2 Dil Lab Dup	TRIP BLK Site 1	Source Area Site 2	9 POP 2 Site 2	TRIP BLANK Site 2	QC0816A 20 ppb	QC0816B 200 ppb	QC0816C 20 ppb	BL0816A
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	23.7	191	22.0	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	25.4	187	24.1	ND
T-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	22.1	195	22.2	ND
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	20.6	202	20.6	ND
C-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	19.8	198	20.2	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	17.3	208	18.2	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	22.1	187	21.5	ND
CARBON TETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	22.4	178	21.6	ND
BENZENE	ND	ND	996	1070	ND	41.0	2.9	1.6	20.5	200	21.7	ND
1,2-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	17.3	202	19.0	ND
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	18.8	184	18.8	ND
TOLUENE	---	---	2810	3270	---	77.5	59.0	11.7	19.3	204	20.3	ND
TETRACHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	21.6	180	21.5	ND
CHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	19.3	200	20.5	ND
ETHYLBENZENE	9.0	8.4	1550	1820	ND	82.7	52.5	ND	19.6	203	19.8	ND
m+p-XYLENE	10.2	12.8	5430	6160	---	387	239	4.7	40.8 **	408 ***	42.0 **	ND
o-XYLENE	13.7	13.4	2760	3030	ND	243	140	1.7	19.0	211	20.6	ND
1,3,5-TRIMETHYLBENZENE	2.0	2.6	2080	2270	ND	120	113	---	20.2	213	20.7	ND
1,2,4-TRIMETHYLBENZENE	13.0	13.7	4630	5200	ND	398	377	---	19.5	226	20.9	ND
1,2,3-TRIMETHYLBENZENE	8.0	8.5	2380	2630	ND	264	229	ND	18.9	225	20.8	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	18.7	202	20.1	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	19.5	218	20.8	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	18.2	203	20.2	ND

ND = None Detected ---- = Below Calibration Limit(1.0 ppb) * = Floating Free Product in Voa. QC = Quality Control Std. BL = Blank
** = 40 ppb in QC *** = 400 ppb in QC

NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Subsurface Protection and Remediation Division

(Robert S. Kerr Environmental Research Center)

919 Kerr Research Drive

Post Office Box 1198 Ada, Oklahoma 74820

Fax: 405-436-8703

fax transmittal

to: Craig Snyder

fax: 303/831-8208

from: DON H. KAMPBELL

phone: Tel: 405-436-8564

FAX: 405-436-8703

E-mail: kampbell.donald@epamail.epa.gov

date: 11/18/96

pages: one, including cover sheet

NOTES: Floating product data for Pope-SJAFB-Site1

Benzene = 246 ug/ml	p-xylene = 1172 ug/ml
Toluene = 1631	o-xylene = 2313
Ethylbenzene: 1239	m-xylene = 4042

October 14, 1997

Pope JP-8 release site 1996

Don Kampbell

As you requested today, here are my results of BTEXXX semiquantitation of Pope AFB "Site 2 (7-17-96)" floating product. The sample was analysed by scan mode GC/MSD as a 1/20 methylene chloride dilution, on August 16, 1997. Semiquantitation was based on area counts resulting from single target ion extraction, ratioed to a 500 ug/ml standard which was run the same day as the floating product sample. This GC/MS analysis was originally performed under service request SF-2-224.

<u>Quantitation</u> *(in units of ug/ml)*:

Benzene .... ND
Toluene .... ND
Ethylbenzene 63
p-Xylene 111
m-Xylene 441
o-Xylene 453

David A. Kovacs

MANTECH

Ref: 97-LB26
March 20, 1997

Myrtle Beach
&
Shaw

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: Steve Vandegrift SV

Dear Don:

Please find attached the analytical results for Service Request SF-3-258 requesting the analysis of aqueous samples for weathering data to be analyzed for Benzene, Toluene, Ethylbenzene, p-, m-, and o-Xylene, 1,3,5-, 1,2,4-, and 1,2,3-Trimethylbenzene, 1,2,4,5-, 1,2,3,5-, and 1,2,3,4-Tetramethylbenzene, Naphthalene, 2-, and 1-Methyl Naphthalene and Total Fuel Carbon. We received your 4 samples, in duplicate, March 12, 1997 in capped, lead lined 40 mL VOA vials. The samples were analyzed on March 19-20, 1997. Samples were stored at 4°C until analyzed. All samples were acquired and processed using the Millennium data system. A 5 point (1-1000 ppb) external calibration curve was used to determine the concentration for BTEXXXTMBs; a 3 point (10-500) external calibration curve was used to determine the concentration for the TetraMBs and Naphthalenes.

Please Note: Sample "SHMW 1610-2" and its duplicate were both analyzed. The concentration results differed greatly between the two samples.

RSKSOP-133 "Simultaneous Analysis of Aromatics and Total Fuel Carbon by Dual Column/Dual Detector Gas Chromatography in Ground Water Samples" was used for these analyses. Autosampling was performed using a Dynatech-Precision autosampler in-line with a Tekmar LSC 2000 sample concentrator.

Sincerely,

Lisa R. Black

Lisa R. Black

xc: R.L. Cosby
G.B. Smith
J.L. Seeley

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

Printed 3/20/97 SF-3-258

Weathering Water Sample Analyses Presented to Dr. D. Kampbell

Units = ng/mL Analyst: L. Black

SampleName	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
QC, OBSERVED, PPB	44.4	48.2	47.1	49.3	50.6	49.3	50.1	49.8	43.6
QC, TRUE VALUE, PPB	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
100 PPB	93.6	97.7	100	99.8	101	98.7	102	100	96.9
MBMP-1	629	2.8	34.5	6.0	64.9	1.6	34.5	112	53.6
MBMP-2	332	2.5	77.3	4.1	49.8	3.7	33.8	209	90.1
SHMW 1610-2	*1460	*1390	605	656	*1770	*1660	284	*1030	546
** SHMW 1610-2	8473	8820	1177	1318	3976	3039	873	2924	1600
SHMW 1610-3	4126	1675	325	407	1007	946	260	927	485
10 PPB	10.4	10.4	9.9	9.7	10.1	9.7	9.5	9.6	9.5

SampleName	1,2,4,5,-TetraMB	1,2,3,5-TetraMB	1,2,3,4-TetraMB	Naphthalene	2-Methyl Naph	1-Methyl Naph	Fuel Carbon
10 PPB	9.3	9.3	9.2	8.6	8.6	8.8	N/A
MBMP-1	49.6	33.8	85.2	251	130	169	3060
MBMP-2	71.5	45.7	130	124	198	258	3240
SHMW 1610-2	75.0	123	123	413	174	205	*9780
** SHMW 1610-2	348	574	473	955	597	687	37800
SHMW 1610-3	69.1	112	109	318	168	190	10800
100 PPB	99.8	100	101	103	98	99.1	N/A

* Value is an estimate due to sample concentration being above the quantitation limit.
** This sample duplicate was analyzed at a 1/10 dilution.

N/A = Not Analyzed

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 97-DK11/vg
April 8, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of methylene chloride soil extracts and "floating product" samples from two of the three sites listed on Service Request #SF-3-258, i.e., Myrtle Beach and Shaw AFB. Samples from the third site, Seymour-Johnson, have not been received at the NRMRL in Ada. All samples in this report were analyzed both for compound identification (GC/MSD scan mode m/z = 39-250) and quantitation of requested target compounds (SIM mode). The following 20 compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2,3-trimethylbenzene (1,2,3-TMB), naphthalene, 2-methylnaphthalene, 1-methylnaphthalene, 2-phenyltoluene (2-methyl-1,1'-biphenyl), 2,6-dimethylnaphthalene, biphenyl, 1,6-dimethylnaphthalene, 1,5-dimethylnaphthalene, 1,2-dimethylnaphthalene, 2,3,5-trimethylnaphthalene, fluorene. In an attempt to give a more complete total of PAH compounds observed, the following classes were semiquantitated: dimethylnaphthalenes (8 isomers), trimethylnaphthalenes (7 isomers), methylbiphenyls (3 isomers) and methylfluorene (3 isomers). In those cases where no actual compound standard was available, the standard curve with the closest retention time in its compound class, was used. This effort, to better quantitate total PAH, was in response to your request for analysis of "any other detectable PAHs". In all, 33 compounds were analyzed either quantitatively or semiquantitatively.

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 µl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) in series with a 30m X 0.25mm J&W DB-624 (1.4um film) plus a 4" X 0.53 mm ID uncoated capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 µg/ml except for

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

fluorene where a single concentration (100 ug/ml) was used. Methylene chloride blanks and "trip" blanks were analyzed to avoid "false positives". No contaminating compounds were found in the "trip blank". A small amount of chromatographic carryover of PAH compounds was observed following analysis of the "floating product" samples. This carryover is compensated for by increasing the "below limit of quantitation" (BLQ) value from 0.025 ug/ml to 0.1 ug/ml. The "floating product" samples were analyzed as 1:20 methylene chloride dilutions. Complete reports detailing the acquisition method and calibration curves have been recorded. The scan mode analyses, for compound identification, were performed March 14-15, 1997. SIM mode analyses for quantitation of target compounds was performed April 1-2, 1997.

The following data is attached:

1. A table of target compound quantitation for each of the soil and "floating product" samples.
2. Example chromatograms from the Mrytle Beach and Shaw AFB soil extracts (scan and SIM mode)
3. Example scan mode chromatograms, including serial expansion, for the Mrytle Beach and Shaw AFB "floating product" samples. Only one of the two samples from each site is reported here since they were qualitatively similar. A mass spectral library search report accompanies each chromatogram.

<u>Special Note Regarding Soil Samples</u>: Original 40 ml sample VOAs (5 ml methylene chloride and 5 ml water) were received completely filled with soil(no headspace). A portion of the soil sample (about 10 g) from the original VOA vial was placed in another VOA with 5 ml methylene chloride and 5 ml water. The actual weight of this soil sample was measured and recorded. Extraction proceeded as usual from this point. The calculation of target compound soil concentration was based on a 5.0 ml extract volume.

Scan mode acquisition was performed for all soil extracts and "floating product" samples. Compound identification for samples not reported here is available upon request. If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G.B. Smith

SF-3-258 Myrtle Beach and Shaw AFB D. Kampbell Floating Product and $MeCl_2$ Soil Extracts Units = mg/kg

Sample	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Naphthalene
Floating Product										
ug/mL, ppm										
MBW 8I	2.11E+02	7.54E+00	1.36E+03	8.10E+02	3.44E+03	1.21E+01	3.55E+03	6.16E+03	2.58E+03	1.16E+03
MBW 24	5.62E+01	5.57E+00	6.00E+02	3.13E+02	1.81E+03	1.42E+01	2.84E+03	6.50E+03	2.98E+03	8.92E+02
SHMW1610-2	2.25E+03	4.89E+03	1.34E+03	1.44E+03	4.14E+03	2.95E+03	3.45E+03	5.79E+03	2.99E+03	1.12E+03
SH1610-3	1.38E+03	2.51E+03	9.35E+02	1.19E+03	3.24E+03	2.39E+03	4.11E+03	7.28E+03	3.78E+03	1.44E+03
Soil Extracts										
mg/kg										
MBSB-1-9.5'	1.10E+00	ND	2.38E+00	1.10E+00	5.69E+00	1.31E-01	2.82E+00	9.66E+00	4.17E+00	3.42E+00
MBSB-2-9.5'	1.71E+00	3.03E-02	8.47E+00	4.97E-01	1.09E+01	5.03E-02	9.51E+00	3.64E+01	1.47E+01	6.88E+00
SHSB-1-33'	5.44E-01	7.87E-01	2.24E-01	2.57E-01	7.80E-01	5.81E-01	5.27E-01	1.74E+00	9.19E-01	4.13E-01
SHSB-2-33'	5.08E+00	1.08E+01	3.58E+00	4.17E+00	1.22E+01	8.92E+00	1.35E+01	2.52E+01	1.33E+01	5.31E+00
SHSB2-33'D	2.50E+00	5.68E+00	1.92E+00	2.24E+00	6.62E+00	4.75E+00	4.45E+00	1.38E+01	7.31E+00	3.06E+00
Check Standards (ug/ml)										
250	2.64E+02	2.66E+02	2.67E+02	2.67E+02	2.68E+02	2.68E+02	2.68E+02	2.68E+02	2.68E+02	2.66E+02
250	2.72E+02	2.76E+02	2.78E+02	2.77E+02	2.79E+02	2.78E+02	2.79E+02	2.78E+02	2.80E+02	2.75E+02
2.5	2.58E+00	2.57E+00	2.53E+00	2.44E+00	2.47E+00	2.45E+00	2.49E+00	2.46E+00	2.53E+00	2.72E+00
250 QC	2.42E+02	2.58E+02	2.59E+02	2.62E+02	2.66E+02	2.63E+02	2.80E+02	2.63E+02	2.64E+02	2.55E+02
100 PNA QC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.68E+01
Trip Blank	ND	ND	ND	ND	ND	ND	ND	BLQ	ND	ND
MeCl2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

BLQ < 0.25 ug/ml (benzene to 1,2,3-TMB)
BLQ < 0.1 ug/ml (naphthalene to fluorene)

Analyst: David A. Kovacs

SF-3-258 Myrtle Beach and Shaw AFB D. Kampbell   Floating Product and $MeCl_2$ Soil Extracts   Units = mg/kg

Sample	2-methylnaphthalene	1-methylnaphthalene	2-phenyltoluene	2,6-dimethylnaphthalene	Biphenyl	1,6-dimethylnaphthalene
Floating Product						
MBW 8I	1.91E+03	1.30E+03	3.46E+01	7.66E+02	2.25E+02	1.14E+03
MBW 24	1.81E+03	1.32E+03	4.20E+01	9.11E+02	2.35E+02	1.36E+03
SHMW1610-2	1.68E+03	1.04E+03	3.99E+01	6.81E+02	2.35E+02	8.60E+02
SH1610-3	2.49E+03	1.48E+03	4.81E+01	1.07E+03	3.12E+02	1.33E+03
Soil Extracts						
MBSB-1-9.5'	3.93E+00	2.71E+00	5.75E-02	1.25E+00	4.61E-01	1.87E+00
MBSB-2-9.5'	1.15E+01	7.62E+00	2.01E-01	4.49E+00	1.32E+00	6.85E+00
SHSB-1-33'	7.20E-01	4.56E-01	4.32E-02	3.38E-01	1.52E-01	4.32E-01
SHSB-2-33'	8.72E+00	5.31E+00	1.99E-01	3.83E+00	1.17E+00	4.93E+00
SHSB2-33'D	5.05E+00	3.09E+00	1.08E-01	2.22E+00	7.02E-01	2.87E+00
Check Standards (ug/ml)						
250	2.65E+02	2.66E+02	2.66E+02	2.66E+02	2.66E+02	2.65E+02
250	2.74E+02	2.76E+02	2.77E+02	2.75E+02	2.75E+02	2.76E+02
2.5	2.44E+00	2.41E+00	2.35E+00	2.33E+00	2.42E+00	2.36E+00
250 QC	2.55E+02	2.47E+02	N/A	N/A	N/A	N/A
100 PNA QC	N/A	N/A	N/A	N/A	N/A	N/A
Trip Blank	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
MeCl2	ND	ND	ND	BLQ	ND	ND

BLQ < 0.25 ug/ml (benzene to 1,2,3-TMB)
BLQ < 0.1 ug/ml (naphthalene to fluorene)

Analyst: David A. Kovacs

SF-3-258 Myrtle Beach and Shaw AFB D. Kampbell Floating Product and $MeCl_2$ Soil Extracts Units = mg/kg

Sample	1,5-dimethylnaphthalene	1,2-dimethylnaphthalene	2,3,5-trimethylnaphthalene	Fluorene	Dimethylnaphthalenes Total of 8 isomers
Floating Product					
MBW 8I	2.08E+02	1.54E+02	8.29E+01	1.46E+01	3.35E+03
MBW 24	2.60E+02	1.70E+02	1.05E+02	1.61E+01	3.97E+03
SHMW1610-2	1.49E+02	1.04E+02	7.69E+01	3.98E+01	2.72E+03
SH1610-3	2.54E+02	1.51E+02	1.03E+02	3.42E+01	4.18E+03
Soil Extracts					
MBSB-1-9.5'	3.13E-01	3.03E-01	1.63E-01	2.83E-02	5.46E+00
MBSB-2-9.5'	1.14E+00	9.54E-01	4.89E-01	7.10E-02	2.06E+01
SHSB-1-33'	1.10E-01	8.55E-02	5.79E-02	1.97E-02	1.27E+00
SHSB-2-33'	9.56E-01	6.07E-01	4.07E-01	1.44E-01	1.56E+01
SHSB2-33'D	5.33E-01	3.81E-01	2.77E-01	8.07E-02	9.26E+00
Check Standards (ug/ml)					
250	2.52E+02	2.67E+02	2.66E+02	N/A	N/A
250	2.65E+02	2.77E+02	2.78E+02	N/A	N/A
2.5	2.17E+00	2.46E+00	2.46E+00	N/A	N/A
250 QC	N/A	N/A	N/A	N/A	N/A
100 PNA QC	N/A	N/A	N/A	9.37E+01	N/A
Trip Blank	BLQ	BLQ	BLQ	ND	N/A
MeCl2	BLQ	BLQ	BLQ	ND	N/A
MeCl2	BLQ	BLQ	ND	ND	N/A

BLQ < 0.25 ug/ml (benzene to 1,2,3-TMB)
BLQ < 0.1 ug/ml (naphthalene to fluorene)

Analyst: David A. Kovacs

SF-3-258 Myrtle Beach and Shaw AFB D. Kampbell   Floating Product and $MeCl_2$ Soil Extracts   Units = mg/kg

Sample	Trimethylnaphthalenes Total of 7 isomers	Methylbiphenyls Total of 3 isomers	Methylfluorene Total of 3 isomers
Floating Product			
MBW 8I	1.17E+03	2.16E+02	1.69E+01
MBW 24	1.52E+03	2.66E+02	1.95E+01
SHMW1610-2	1.18E+03	2.78E+02	6.25E+01
SH1610-3	1.71E+03	3.24E+02	3.59E+01
Soil Extracts			
MBSB-1-9.5'	1.39E+00	2.52E-01	BLQ
MBSB-2-9.5'	6.73E+00	1.18E+00	1.12E-01
SHSB-1-33'	3.56E-01	7.78E-02	BLQ
SHSB-2-33'	6.06E+00	1.20E+00	1.94E-01
SHSB2-33'D	3.56E+00	6.72E-01	1.31E-01
Check Standards (ug/ml)			
250	N/A	N/A	N/A
250	N/A	N/A	N/A
2.5	N/A	N/A	N/A
250 QC	N/A	N/A	N/A
100 PNA QC	N/A	N/A	N/A
Trip Blank	N/A	N/A	N/A
MeCl2	N/A	N/A	N/A
MeCl2	N/A	N/A	N/A

BLQ < 0.25 ug/ml (benzene to 1,2,3-TMB)
BLQ < 0.1 ug/ml (naphthalene to fluorene)

Analyst: David A. Kovacs

For **SERVICE REQUEST SF-3-258** May 9, 1997
Dr. Don Kampbell

Don:

Here are the floating product densities you requested today.

Myrtle Beach	Density (g/ml)
MBMW-8I	0.750
MBMW-24	0.764
Shaw AFB	
SH1610-3	0.783
SHMW-1610-2	0.765

Let me know if you need anything else ... Dave Kovacs

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 97-RC34/vg

June 6, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Don:

Attached is a report of the data generated from the analyses of five sample core extracts and one trip blank which were submitted under Service Request #SF-3-258. The extracts were analyzed for TPH (total petroleum hydrocarbons) as JP-4 jet fuel. Data from the analyses of calibration check standards and a solvent blank which were analyzed concurrently with the extracts are tabulated in the QC Data section of the report.

Data quantification and component concentration calculations were performed with Millennium chromatography software. JP-4 data was quantified with a 9-point external standard calibration curve ranging from 50 to 50,000 ng/ul.

Sample core extracts were received May 19, 1997, and analyzed May 23 and 24, 1997. All analyses were performed in accordance with RSKSOP-72, Rev. #1. Modifications to RSKSOP-72 are detailed in the attached outline.

Sincerely,

Randy Callaway

Randy Callaway

xc: R.L. Cosby
G.B. Smith
J.T. Wilson
J.L. Seeley

Sample ID	Extract conc (ng/ul)	Original conc (ug/g)	Fuel carbon (ug/g)
MBSB-1-9.5'	1280	632	537
MBSB-2-9.5'	11200	3270	2780
SHSB-1-33'	535	220	187
SHSB-2-33'	6640	2820	2400
SHSB-2-33D	4270	1610	1370
Trip blank	nd		
	QC Data		
blank MeCl2	nd		
500 ng/ul JP-4	535		
5000 ng/ul JP-4	5230		
50000 ng/ul JP-4	49800		

nd = none detected

I. HP5880 GC - OPERATING CONDITIONS (CRYO DISABLED)

A. Instrument Control
   1. Analyses: "TPH 17JAN97"
   2. Program: "RWC-AS40"
   3. Calibration: "REF ALKANE"

B. Temperature Program
   1. Initial Temp & Time: 40C for 3.00 min
   2. Level 1: Rate = 10C/min to 290C, Final time = 2.00 min
   3. Run Time: 30.00 min
   4. Oven Equilibration Time: 1.00 min

C. Miscellaneous
   1. Peak Width: 0.02
   2. Attenuation: 2^5
   3. Chart Speed: 0.50
   4. Threshold: 4
   5. Offset: 10%

II. MILLENNIUM PROCESSING METHOD PARAMETERS

A. Integration Window
   1. Peak Width: 500
   2. Minimum Area: 1
   3. Threshold: 200
   4. Minimum Height: 1
   5. Timed Events:

	Start	Event Description	Value	Stop
a.	2.800	Valley-to-Valley		22.999
b.	23.000	Set Minimum Height	800.00	

B. Component Table Window
   1. Component: JP-4
   2. Retention Time: 2.80 to 25.00 min
   3. Quantified by: area
   4. Calibration Curve
      a. Range: 50 - 50,000 ng/ul
      b. Curve Fit: quadratic
      c. Weighting: 1/X

C. QuickSet Parameters for Data Acquisition
   1. Data Start: 2.50 min
   2. Run Time: 30.00 min
   3. Acquisition Rate: 5 points/sec

~~CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST~~

~~Evergreen Analytical Inc.~~ NRMRL

~~4036 Youngfield St.~~
~~Wheat Ridge, Colorado 80033~~
~~(303) 425-6021~~
~~FAX (303) 425-6854~~
~~(800) 845-7400~~

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-~~423-8344~~ 831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D. Fuel Weathering
EAL. QUOTE # ____ P.O.# 729691.35730
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder
Evergreen Analytical Cooler No.____
Cooler Received____

Myrtle Beach AFB Samples

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL
Project #____
Custodian____

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: Oil / Sludge Free Product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	~~TVPH 8015mod. (Gasoline)~~ Total Fuel Carbon	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	TMB's	Napthalene & Methylnapthalenes	~~Moisture~~	Density			EAL Sample No.
MBSB-1-9.5	3/4/97	1010	1		X									X		X				X	X	~~X~~				
MBSB-2-9.5	3/4/97	1430	1		X									X		X				X	X	~~X~~				
MBMP-1	3/4/97	1140	2	X										X						X	X					
MB MP-2	3/4/97	1530	2	X										X						X	X					
MB MW-8I	3/4/97	1500	1			X								X						X	X		X			
MB MW-24	3/4/97	1645	1			X								X						X	X		X			
HT:																										Location
DD:																										Container Size

Instructions: Fuel Weathering Study samples: Please perform - Mass fraction BTEX, TMB's, Napthalene & Methylnaphthalenes and Density on Free Product
Myrtle Beach - JP-4 Release Site - BTEX, TMBs, Naphthalene & Methyl napthalenes on groundwater
~~Shaw - JP-4 Release Site~~ * Use Original Tare on Soil samples - BTEX, TMBs, ~~TPH (gasoline)~~ Fuel Carbon, Napthalene, Methylnapthalenes, ~~Moisture~~ on Soil

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	3/6/97						

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc. NRMRL
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-9208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D. ~~729691~~ Fuel Weathering
EAL. QUOTE # ____ P.O.# 729691.35730
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)____
*expedited turnaround subject to additional fee

Sampler Name: Shaw AFB Samples
(signature) Craig B. Snyder
(print) Craig B. Snyder

Evergreen Analytical Cooler No.____
Cooler Received____

Please **PRINT** all information:

EAL use only
Do not write in shaded area
EAL
Project #____
Custodian____

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: ~~Oil / Sludge~~ Free Product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Fuel Carbon	Methylnaphthalenes + Naphthalene	TMB's	Density	EAL Sample No.
SH SB-1-33	3/5/97	1530	1		X									X						X	X	X		
SH SB-2-33	3/5/97	1745	1		X									X						X	X	X		
SH SB-22-33	3/5/97	1745	1		X									X						X	X	X		
SH MW 1610-2	3/6/97	0830	2	X										X							X	X		
SH MW 1610-3	3/6/97	0845	2	X										X							X	X		
SHMW1610-2	3/6/97	0800				X								X							X	X	X	
SHMW1610-3	3/6/97	0810				X								X							X	X	X	

HT: Location
DD: Container Size

Instructions: Fuel Weathering Study Samples: Please perform Mass fraction determination of BTEX, TMB's, Napthaline, and methylnapthalenes on Free Product Samples as well as Density. See above for GW & Soil analyses.
Use original tare weight on soil samples

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

MANTECH
TECHNOLOGY

Ref: 97-DK20/vg
July 29, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Beaufort Marine Air Station
Hanahan Defense Fuel Supply
Cecil Field Naval Air Station
Seymour-Johnson AFB

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of methylene chloride soil extracts and "fuel product" samples for Service Request #SF-3-268. The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2,3-trimethylbenzene (1,2,3-TMB), naphthalene, 2-methylnaphthalene and 1-methylnaphthalene.

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 µl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) plus an SGE 0.3m X 0.53 mm ID deactivated Carbowax deactivated capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 µg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The "floating product" samples were analyzed as 1:40 methylene chloride dilutions except for samples "MW-349-1FP" and "MW-349-6FP" where a 1/400 dilution was also required. Complete reports detailing the acquisition method and calibration curves have been recorded. SIM mode analyses for quantitation of target compounds was performed July 25-26, 1997. Fuel product densities were measured and are recorded on the attached data report.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G.B. Smith

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
Core Samples (mg/kg)									
BUDTSB-3.5'	3.25E+00	7.86E-02	2.39E+01	ND	ND	8.12E-02	1.40E-02	2.87E-01	2.80E+01
BUTFC-SB1-4'	4.57E-02	5.60E-01	3.35E+00	1.98E+00	5.02E+00	3.95E+00	9.58E+00	3.34E+01	2.06E+01
BUTFC-SB2-3.5'	3.75E-01	3.82E-01	1.53E+01	8.94E+00	2.29E+01	1.37E+01	4.35E+01	1.48E+02	9.55E+01
CFSB1-8.5'	9.53E-01	1.72E+01	1.41E+02	1.14E+02	2.33E+02	3.28E+01	8.63E+01	2.10E+02	8.84E+01
CFSB3-8.5'	1.20E-02	2.08E-01	1.47E+00	1.31E+00	3.26E+00	6.66E-01	7.05E+00	2.15E+01	1.39E+01
CFSB11-8.5'	9.76E-01	1.91E+01	1.55E+02	1.25E+02	2.63E+02	3.74E+01	9.69E+01	2.38E+02	9.98E+01
CHARSB1-14.5'	ND	1.73E-02	BLQ	BLQ	BLQ	BLQ	BLQ	ND	ND
CHSB2-12'	3.67E-02	3.54E-02	1.34E-01	1.99E-01	4.52E-01	1.52E-01	1.67E-01	3.31E-01	1.68E-01
CHSB2-13'	1.05E+00	2.17E+01	3.43E+01	3.80E+01	9.00E+01	4.52E+01	2.17E+01	4.59E+01	2.14E+01
SJSB1-5.5'	1.08E+01	6.47E+01	5.61E+01	5.36E+01	1.52E+02	8.67E+01	1.02E+02	2.69E+02	1.19E+02
SJSB2-5.5'	1.25E+01	5.63E+01	7.53E+01	7.54E+01	2.17E+02	1.24E+02	1.56E+02	4.34E+02	2.08E+02
Fuel Product (ug/ml)									
SJMW25FP	1.90E+02	1.03E+03	1.16E+03	1.12E+03	3.16E+03	1.77E+03	2.13E+03	5.65E+03	2.75E+03
CEF-293-9FP	2.35E+01	1.22E+02	2.52E+03	1.67E+03	2.80E+03	3.17E+02	1.40E+03	4.00E+03	1.86E+03
CH-MW-103	BLQ	2.04E+02	8.56E+02	9.68E+02	2.43E+03	1.00E+03	1.04E+03	2.18E+03	9.53E+02
CH-EW68	BLQ	1.35E+00	9.13E+01	1.10E+02	2.20E+02	2.12E+01	5.41E+02	7.64E+02	4.48E+02
SJMW15FP	1.94E+02	1.03E+03	1.17E+03	1.11E+03	3.12E+03	1.76E+03	2.10E+03	5.59E+03	2.72E+03
"FRESH"JP5	1.50E+00	3.64E+01	3.27E+02	3.17E+02	7.62E+02	7.88E+02	1.10E+03	4.17E+03	2.39E+03
Fuel Product ... mass fraction ... (concentration/density)									
SJMW25FP , d=0.774 g/ml	2.46E-04	1.33E-03	1.50E-03	1.45E-03	4.08E-03	2.29E-03	2.76E-03	7.29E-03	3.56E-03
CEF-293-9FP , d=0.799 g/ml	2.94E-05	1.52E-04	3.15E-03	2.08E-03	3.50E-03	3.97E-04	1.75E-03	5.01E-03	2.32E-03
CH-MW-103 , d=0.760 g/ml	BLQ	2.69E-04	1.13E-03	1.27E-03	3.19E-03	1.32E-03	1.37E-03	2.87E-03	1.25E-03
CH-EW6 , d=0.796 g/ml	BLQ	1.70E-06	1.15E-04	1.38E-04	2.76E-04	2.66E-05	6.79E-04	9.60E-04	5.63E-04
SJMW15FP , 0.793 g/ml	2.45E-04	1.30E-03	1.48E-03	1.40E-03	3.93E-03	2.22E-03	2.64E-03	7.06E-03	3.43E-03
"FRESH" JP5 , d=0.780 g/ml	1.92E-06	4.67E-05	4.20E-04	4.06E-04	9.78E-04	1.01E-03	1.40E-03	5.35E-03	3.06E-03

BLQ<0.025 ug/ml

	Naphthalene	2-methylnaphthalene	1-methylnaphthalene
Core Samples (mg/kg)			
BUDTSB-3.5'	2.70E+01	4.43E+01	2.98E+01
BUTFC-SB1-4'	1.25E+01	2.74E+01	2.05E+01
BUTFC-SB2-3.5'	5.49E+01	1.15E+02	8.73E+01
CFSB1-8.5'	7.40E+01	1.33E+02	8.43E+01
CFSB3-8.5'	1.43E+01	2.55E+01	1.64E+01
CFSB11-8.5'	8.26E+01	1.50E+02	9.44E+01
CHARSB1-14.5'	BLQ	BLQ	BLQ
CHSB2-12'	9.35E-02	2.36E-01	1.89E-01
CHSB2-13'	1.97E+01	3.37E+01	2.68E+01
SJSB1-5.5'	5.53E+01	9.69E+01	6.24E+01
SJSB2-5.5'	9.47E+01	1.72E+02	1.13E+02
Fuel Product (ug/ml)			
SJMW25FP	1.29E+03	2.32E+03	1.49E+03
CEF-293-9FP	1.88E+03	3.32E+03	2.29E+03
CH-MW-103	5.02E+02	1.80E+03	1.40E+03
CH-EW68	4.46E+02	1.75E+03	1.48E+03
SJMW15FP	1.28E+03	2.29E+03	1.51E+03
"FRESH"JP5	9.38E+02	2.30E+03	1.77E+03
Fuel Product ... mass fraction ... (concentration/density)			
SJMW25FP , d=0.774 g/ml	1.67E-03	3.00E-03	1.92E-03
CEF-293-9FP , d=0.799 g/ml	2.36E-03	4.15E-03	2.86E-03
CH-MW-103 , d=0.760 g/ml	6.61E-04	2.37E-03	1.84E-03
CH-EW6 , d=0.796 g/ml	5.61E-04	2.20E-03	1.86E-03
SJMW15FP , 0.793 g/ml	1.61E-03	2.89E-03	1.90E-03
"FRESH" JP5 , d=0.780 g/ml	1.20E-03	2.95E-03	2.27E-03

BLQ<0.025 ug/ml

Check Standards (ug/ml)	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
250	2.49E+02	2.52E+02	2.49E+02	2.51E+02	2.50E+02	2.48E+02	2.48E+02	2.48E+02	2.48E+02
25	2.71E+01	2.67E+01	2.48E+01	2.64E+01	2.64E+01	2.59E+01	2.66E+01	2.43E+01	2.61E+01
25	2.56E+01	2.61E+01	2.46E+01	2.63E+01	2.66E+01	2.64E+01	2.70E+01	2.65E+01	2.64E+01
25	2.36E+01	2.40E+01	2.24E+01	2.36E+01	2.40E+01	2.43E+01	2.48E+01	2.43E+01	2.42E+01
25	2.35E+01	2.32E+01	2.17E+01	2.32E+01	2.32E+01	2.32E+01	2.37E+01	2.33E+01	2.33E+01
2.5	2.65E+00	2.68E+00	2.59E+00	2.59E+00	2.63E+00	2.62E+00	2.53E+00	2.67E+00	2.66E+00
2.5	2.32E+00	2.36E+00	2.29E+00	2.29E+00	2.34E+00	2.37E+00	2.42E+00	2.40E+00	2.36E+00
0.25	2.45E-01	2.67E-01	2.36E-01	2.35E-01	2.48E-01	2.41E-01	2.30E-01	2.45E-01	2.68E-01
SF-3-268 Method Blank	ND	9.99E-02	ND	BLQ	4.37E-02	BLQ	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
QC (expected)	5.00E+01	6.00E+01	6.00E+01	6.00E+01	5.00E+01	6.00E+01	5.00E+01	5.00E+01	5.00E+01
QC (observed)	5.15E+01	6.07E+01	6.27E+01	6.41E+01	5.02E+01	5.92E+01	4.70E+01	4.81E+01	5.29E+01

BLQ<0.025 ug/ml

Check Standards (ug/ml)	Naphthalene	2-methylnaphthalene	1-methylnaphthalene
250	2.49E+02	2.48E+02	2.64E+02
25	2.65E+01	2.66E+01	2.78E+01
25	2.68E+01	2.64E+01	2.72E+01
25	2.39E+01	2.45E+01	2.46E+01
25	2.35E+01	2.29E+01	2.35E+01
2.5	2.66E+00	2.64E+00	2.66E+00
2.5	2.35E+00	2.35E+00	2.34E+00
0.25	2.53E-01	2.42E-01	2.51E-01
SF-3-268 Method Blank	ND	ND	ND
Methylene Chloride	ND	ND	ND
QC (expected)	N/A	N/A	N/A
QC (observed)	N/A	N/A	N/A

BLQ<0.025 ug/ml

MANTECH ENVIRONMENTAL TECHNOLOGY

Fuel Carbon in Soil

Seymour Johnson
Charleston DFSP
Cecil Field NAS
Beaufort MCAS

Ref: 97-RC37/vg

July 1, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Don:

Attached is a report of the data generated from the analyses of 11 sample core extracts and one method blank which were submitted under Service Request #SF-3-268. The extracts were analyzed for TPH (total petroleum hydrocarbons) as JP-4 jet fuel. Data from the analyses of calibration check standards and a solvent blanks which were analyzed concurrently with the extracts are tabulated in the QC Data section of the report.

Data quantification, dilution factor corrections, and component concentration calculations were performed with Millennium chromatography software. JP-4 data was quantified with a 9-point external standard calibration curve ranging from 50 to 50,000 ng/ul.

Sample core extracts were received June 5, 1997, and analyzed June 5 and 6, 1997. Dilutions were also prepared and analyzed June 6, 1997. All analyses were performed in accordance with RSKSOP-72, Rev. #1. Modifications to RSKSOP-72 are detailed in the attached outline.

Sincerely,

Randy Callaway

Randy Callaway

xc: R.L. Cosby
G.B. Smith
J.T. Wilson
J.L. Seeley

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

Sample ID	Extract conc (ng/ul)	Original conc (ug/g)	Fuel carbon (ug/g)
BUDTSB-3.5' ✓	16100	4960	4220
BUTFC-SB1-4' ✓	18300	5700	4840
BUTFC-SB2-3.5' (1:10) ✓	80600	23900	20300
CFSB1-8.5' (1:10) ✓	108000	33700	28700
CFSB3-8.5' ✓	11700	3870	3290
CFSB11-8.5' (1:20) ✓	119000	34200	29100
CHARSB1-14.5' ✓	nd		
CHSB2-12' ✓	273	79.1	67.2
CHSB2-13' ✓	33300	11500	9790
SJSB1-5.5' (1:10) ✓	69700	26100	22200
SJSB2-5.5' (1:20) ✓	137000	47000	39900
Method blank	nd		
	QC Data		
blank MeCl2	nd		
50 ng/ul JP-4	50.3		
500 ng/ul JP-4	549		
5000 ng/ul JP-4	5170		
50000 ng/ul JP-4	51600		
blank MeCl2	nd		
5000 ng/ul JP-4	5150		
10000 ng/ul JP-4	9924		

nd = none detected

I. HP5880 GC - OPERATING CONDITIONS (CRYO DISABLED)

A. Instrument Control
   1. Analyses: "TPH 17JAN97"
   2. Program: "RWC-AS40"
   3. Calibration: "REF ALKANE"

B. Temperature Program
   1. Initial Temp & Time: 40C for 3.00 min
   2. Level 1: Rate = 10C/min to 290C, Final time = 2.00 min
   3. Run Time: 30.00 min
   4. Oven Equilibration Time: 1.00 min

C. Miscellaneous
   1. Peak Width: 0.02
   2. Attenuation: 2^5
   3. Chart Speed: 0.50
   4. Threshold: 4
   5. Offset: 10%

II. MILLENNIUM PROCESSING METHOD PARAMETERS

A. Integration Window
   1. Peak Width: 500
   2. Minimum Area: 1
   3. Threshold: 200
   4. Minimum Height: 1
   5. Timed Events:

	Start	*Event Description*	*Value*	*Stop*
a.	2.800	Valley-to-Valley		22.999
b.	23.000	Set Minimum Height	800.00	

B. Component Table Window
   1. Component: JP-4
   2. Retention Time: 2.80 to 25.00 min
   3. Quantified by: area
   4. Calibration Curve
      a. Range: 50 - 50,000 ng/ul
      b. Curve Fit: quadratic
      c. Weighting: 1/X

C. QuickSet Parameters for Data Acquisition
   1. Data Start: 2.50 min
   2. Run Time: 30.00 min
   3. Acquisition Rate: 5 points/sec

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 97\LB34

May 28, 1997

SJ
CH
Cu F. } GW
BU

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift

Dear Don:

Please find attached the analytical results for Service Request SF-3-268 requesting the analysis of fuel spill site samples to be analyzed by purge-and-trap/GC-PID:FID for Benzene, Toluene, Ethylbenzene, p-, m-, & o-Xylene, 1,3,5-, 1,2,4-, & 1,2,3-Trimethylbenzene, 1,2,4,5-, 1,2,3,5-, & 1,2,3,4-Tetramethylbenzene, Naphthalene, 2-MethylNaphthalene, & 1-MethylNaphthalene and Total Fuel Carbon. We obtained the 8 aqueous samples, in duplicate, in capped, 40 mL VOA autosampler vials May 21, 1997 and they were analyzed May 22-27, 1997. The samples were acquired and processed using the Millennium data system. A 6 place (1-1000 ppb) external calibration curve was used to quantitate sample concentration for BTEXXXTMs. A 4 place (10-500 ppb)external calibration curve was used to quantitate sample concentration for the Naphthalenes, and a 3 place (10-500 ppb)external calibration curve was used to quantitate sample concentration for the TetraMethylbenzenes.

RSKSOP-122, "Analysis of Xylene Isomers in Groundwater by Purge & Trap Gas Chromatography" was used for these analyses. Autosampling was performed using a Dynatech Precision autosampler system in line with a Tekmar LSC 2000 concentrator.

Sincerely,

Lisa R. Black

Lisa R. Black

xc: R.L. Cosby
G.B. Smith
J.T. Wilson
J.L. Seeley

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

Printed 5/28/97 SF-3-268

Aqueous Samples-Weathering Data Presented to Dr. Kampbell

Units = ng/mL Analyst: L. Black

SampleName	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
QC, OBSERVED, PPB	48.1	47.5	47.4	47.4	47.1	47.8	47.7	47.7	48.1
QC, TRUE VALUE, PPB	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
100 PPB	94.5	93.6	92.9	92.2	91.4	92.2	92.3	92.7	93.6
SJMP1	848	4100	842	642	1650	946	259	769	429
SJMW1S	566	1600	635	498	965	569	167	607	296
CF-MP1	90	805	944	752	1500	499	181	580	284
CEF-293-7	4.8	6.1	32.6	29.6	31.2	8.3	34.0	277	233
CEF-293-7 Duplicate	4.1	5.0	29.7	26.9	28.0	7.6	31.3	253	214
BUTFC-MP1	3.5	22.7	121	69	203	176	113	597	460
BUTFC-MP2	49.1	110	206	95	300	307	126	631	503
CHMP1	36.9	884	535	498	952	370	83	292	134
CHMP2	52.3	373	805	750	1800	795	106	382	182
CF-MP11	87.2	795	938	746	1400	491	181	583	287
10 PPB BTEX	9.4	9.6	9.6	9.6	10.4	9.5	9.4	9.5	9.5
500 PPB BTEX	494	510	530	529	530	526	540	540	538

	1,2,4,5-TetraMB	1,2,3,5-TetraMB	1,2,3,4-TetraMB	Naphthalene	2-MethylNaphthalene	1-MethylNaphthalene	Fuel Carbon
QC, OBSERVED, PPB	N/A	N/A	N/A	49.6	54.6	55.7	N/A
QC, TRUE VALUE, PPB	N/A	N/A	N/A	50.0	50.0	50.0	N/A
100 PPB	92.4	92.7	93.4	95.4	95.6	96.0	N/A
SJMP1	37.8	63.4	74.5	254	135	159	12300
SJMW1S	30.2	51.5	63.2	211	110	134	8500
CF-MP1	42.1	65.0	81.0	277	155	180	6300
CEF-293-7	62.9	98.2	121	228	143	187	1000
CEF-293-7 Duplicate	58.3	92.0	114	217	139	183	916
BUTFC-MP1	56.4	97.3	130	275	172	215	2690
BUTFC-MP2	64.6	110	143	309	189	234	3360
CHMP1	18.1	33.6	51.9	151	101	137	5950
CHMP2	21.5	39.7	66.0	211	122	161	8340
CF-MP11	42.7	65.8	81.4	271	151	175	6210
10 PPB	9.5	9.5	9.4	9.4	9.2	9.5	N/A

ND = None Detected; BLQ = Below Limit of Quantitation, 1 ppb, N/A = Not Analyzed

MANAGEMENT TECHNOLOGY

Vroblesky

Ref: 97-DK26/vg
September 12, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of two "fuel product" samples from Hanahan, SC, for Service Request #SF-3-285. The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2,3-trimethylbenzene (1,2,3-TMB), naphthalene, 2-methylnaphthalene (2-MN) and 1-methylnaphthalene (1-MN).

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 µl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) plus an SGE 0.2m X 0.53 mm ID deactivated Carbowax capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 µg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The samples were analyzed as 1:20 methylene chloride dilutions. Complete reports detailing the acquisition method and calibration curves have been recorded. SIM mode analyses for quantitation of target compounds was performed September 9-10, 1997. Fuel densities were measured and are recorded on the attached data report.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G.B. Smith

S.R. SF-3-285 , Dr. Kampbell , Hanahan, SC

GC/SIM-MS Fuel Product

Units = ug/ml

Sample	Benzene	Toluene	EB	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Naphthalene	2-MN	1-MN
EW-6	1.05E+01	4.58E+01	3.85E+02	3.45E+02	1.07E+03	9.25E+01	7.99E+02	1.41E+03	6.27E+02	4.69E+02	1.81E+03	1.53E+03
W-108	9.51E-01	2.63E+01	1.86E+02	7.98E+01	1.76E+02	1.68E+02	6.94E+02	2.19E+03	1.29E+03	9.63E+02	2.99E+03	2.22E+03
Check Standard												
250	2.44E+02	2.47E+02	2.50E+02	2.51E+02	2.51E+02	2.50E+02	2.54E+02	2.53E+02	2.54E+02	2.52E+02	2.55E+02	2.53E+02
25	2.59E+01	2.57E+01	2.54E+01	2.55E+01	2.61E+01	2.56E+01	2.65E+01	2.50E+01	2.51E+01	2.48E+01	2.43E+01	2.50E+01
2.5	2.51E+00	2.49E+00	2.50E+00	2.48E+00	2.51E+00	2.42E+00	2.48E+00	2.49E+00	2.50E+00	2.47E+00	2.47E+00	2.48E+00
2.5	2.48E+00	2.46E+00	2.42E+00	2.33E+00	2.41E+00	2.36E+00	2.48E+00	2.49E+00	2.50E+00	2.46E+00	2.48E+00	2.45E+00
0.25	2.53E-01	2.57E-01	2.42E-01	2.40E-01	2.50E-01	2.49E-01	2.37E-01	2.42E-01	2.60E-01	2.66E-01	2.65E-01	2.58E-01
0.025	2.47E-02	2.65E-02	2.51E-02	2.40E-02	2.66E-02	2.57E-02	2.73E-02	2.77E-02	2.74E-02	2.78E-02	3.28E-02	3.31E-02
QC Standard												
25	2.41E+01	2.42E+01	2.41E+01	2.38E+01	2.36E+01	2.41E+01	2.33E+01	2.46E+01	2.46E+01	2.47E+01	2.53E+01	2.52E+01
25	2.53E+01	2.52E+01	2.54E+01	2.60E+01	2.50E+01	2.49E+01	2.39E+01	2.55E+01	2.57E+01	2.55E+01	2.61E+01	2.60E+01
25	2.56E+01	2.59E+01	2.58E+01	2.61E+01	2.53E+01	2.55E+01	2.44E+01	2.59E+01	2.60E+01	2.59E+01	2.66E+01	2.64E+01
$MeCl_2$	ND	BLQ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

The following fuel product density (g/ml) was determined:

EW-6	0.8057
W-108	0.8131

Analyst: D.A. Kovacs

Sample BLQ < 0.5 ug/ml

Printed: 9/12/97

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted]HA[redacted]OF [redacted]ST[redacted] R[redacted]OR[redacted]AN[redacted]TI[redacted]L S[redacted]VIC[redacted]RE[redacted]ES[redacted] [redacted] [redacted]

~~Evergreen Analytical Inc.~~ NRMRL
~~4036 Youngfield St.~~
~~Wheat Ridge, Colorado 80033~~
~~(303) 425-6021~~
~~FAX (303) 425-6854~~
~~(800) 845-7400~~

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
CLIENT PROJ. I.D. Fuel Weathering
EAL. QUOTE # ______ P.O.# 729691.3
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ UST
☐ Other (Specify)* ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: ~~Oil / Sludge / Multi-phase~~ FREE PRODUCT	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	Total Fuel Carbon	TMB's	Naphthalene & Methylnaphthalenes	Density	
SJSB1 - 5.5'	5/14/97	1805	1		X									X							X	X	X		
SJSB2 - 5.5'	5/15/97	1000	1		X									X							X	X	X		
SJMP1	5/14/97	1905	2	X										X								X	X		
SJMW15	5/15/97	1215	2	X										X								X	X		
SJMW1SFP	5/15/97	0900	1			X								X								X	X	X	
SJMW2SFP	5/15/97	0900	1			X								X								X	X	X	
CHABSB1 - 14.5'	5/16/97	0935	1		X									X							X	X	X		
CHSB2 - 12'	5/16/97	1405	1		X									X							X	X	X		
CHSB2 - 13'	5/16/97	1405	1		X									X							X	X	X		
CH-MW103	5/16/97	1600	1			X								X								X	X	X	
			Sample Fraction																						
			Container																						

For Laboratory use only
W.O. # ______
B.O.F. # ______
C/S (O) ______
C/S (I) ______
Cooler Temp. °C ______
Seals Intact Y / N /
Samples Pres. Y /
Headspace Y / N /
By ______ /
Loc

Instructions: SJ = Bldg 4522, Seymour Johnson AFB, NC - Dec '95 JP-8 Release. Groundwater @ 5.5' bgs; CH = DFSP-Charleston, SC - Oct JP-4 Fuel Release

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Craig B. Snyder	5/20/97 1800					

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc. NRMRL
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
CLIENT PROJ. I.D. Fuel Weathering
EAL QUOTE # ____ P.O.# 729691.3
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ UST
☐ Other (Specify)* ____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil/Solid/Air/Gas	MATRIX: ~~Oil/Sludge/Multi-phase~~ FREE PRODUCT	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	Total Fuel Carbon	TMB's	Naphthalene & Methylnaphthalenes	Density
CH-EW6	5/17/97	1130	1											X								X	X	X
CH-MP1	5/16/97	1600	2	X										X								X	X	
CH-MP2	5/17/97	0940	2	X										X								X	X	
BUTFC-SB1-4'	5/19/97	0945	1		X									X							X	X	X	
BUTFC-SB2-3.5'	5/19/97	1015	1		X									X							X	X	X	
BUDT-SB-3.5'	5/19/97	1410	1		X									X							X	X	X	
Fresh JP-5	5/19/97	0930	1			X								X								X	X	X
BUTFC-MP1	5/19/97	1110	2	X										X								X	X	
BUTFC-MP2	5/19/97	1130	2	X										X								X	X	
CEF-293-9FP	5/20/97	1120	1			X								X								X	X	X

Sample Fraction
Container

For Laboratory use only
W.O. #
B.O.F. #
C/S (O) /
C/S (I) /
Cooler Temp. °C
Seals Intact Y / N / NA
Samples Pres. Y / N / NA
Headspace Y / N / NA
By /
Loc

Instructions:
BUTFC = Beaufort MCAS, Tank Farm C; BUDT = Beaufort MCAS, Day Tank 865
CEF & CF = Cecil Field NAS, Facility 293

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	5/20/97 1800						

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
NRMRL

4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY Parsons ES
ADDRESS 1700 Broadway, Ste 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
CLIENT PROJ. I.D. Fuel Weathering S
EAL. QUOTE # P.O.#
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ UST ☐ Other (Specify)*
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: Oil / Sludge / Multi-phase	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	Total Fuel Carbon	TMB's	Naphthalene & Meth/Naphthalenes	Density		
CF-MP1	5/20/97	1040	2	X										X								X	X			
CF-MP11	5/20/97	1040	2	X										X								X	X			
MW CEF-293-7	5/20/97	1300	2	X										X								X	X			
CF-SB1-8.5	5/20/97	0945	1	~~X~~	X									X							X	X	X			
CF-SB11-8.5	5/20/97	0945	1	~~X~~	X									X							X	X	X			
CF-SB3-8.5	5/20/97	1215	1	~~X~~	X									X							X	X	X			

Sample Fraction
Container
Instructions:

For Laboratory use only
W.O. #
B.O.F. #
C/S (O)
C/S (I)
Cooler Temp. °C
Seals Intact Y / N /
Samples Pres. Y /
Headspace Y / N /
By /
Loc

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Craig B. Snyder	5/20/97 1800					

MANTECH

Ref: 97-DK29/vg
October 9, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

McChord Free Product
Tank Farm C Free Product

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of two floating product samples for Service Request #SF-4-292. One sample, designated "WA-CR02", was from McChord AFB, WA. The other sample was designated "Tank Farm C, JP-5" and was from MCAS Beaufort, SC. The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2,3-trimethylbenzene (1,2,3-TMB), naphthalene, 2-methylnaphthalene and 1-methylnaphthalene.

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 µl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) plus an SGE 0.2m X 0.53 mm ID deactivated Carbowax capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 µg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The samples were analyzed as 1:40 methylene chloride dilutions. Complete reports detailing the acquisition method and calibration curves have been recorded. Both samples were received October 7, 1997 and the SIM mode analyses for quantitation of target compounds were performed the same day.

Floating product densities were measured and are as follows:

WA-CR02 McChord AFB, WA .... 0.8512 g/ml
Tank Farm C MCAS Beaufort, SC JP-5 .... 0.8044 g/ml

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley SV FHV
G.B. Smith

Sample	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene
WA-CR02 McChord AFB, WA	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
~~Tank Farm C MCAS Beaufort, SC JP-5~~	2.23E+00	1.30E+01	1.16E+02	9.96E+01	2.24E+02	2.87E+02
Check Standards						
methylene chloride	ND	ND	ND	ND	ND	ND
0.25	2.56E-01	2.53E-01	2.54E-01	2.41E-01	2.63E-01	2.60E-01
2.5	2.48E+00	2.49E+00	2.52E+00	2.54E+00	2.52E+00	2.51E+00
25	2.47E+01	2.49E+01	2.53E+01	2.54E+01	2.52E+01	2.52E+01
25 QC	2.50E+01	2.54E+01	2.58E+01	2.69E+01	2.46E+01	2.52E+01
25 QC	2.42E+01	2.48E+01	2.51E+01	2.57E+01	2.43E+01	2.47E+01

BFT-401-3

Sample	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Naphthalene	2-methylnaphthalene	1-methylnaphthalene
WA-CR02 McChord AFB, WA	4.37E+00	4.44E+01	5.56E+01	BLQ	1.22E+02	1.32E+02
~~Tank Farm C MCAS Beaufort, SC JP-5~~	8.56E+02	2.06E+03	1.70E+03	4.55E+02	1.50E+03	1.29E+03
Check Standards						
methylene chloride	ND	ND	ND	ND	ND	BLQ
0.25	2.71E-01	2.65E-01	2.57E-01	2.68E-01	2.73E-01	2.64E-01
2.5	2.38E+00	2.49E+00	2.50E+00	2.51E+00	2.49E+00	2.49E+00
25	2.53E+01	2.54E+01	2.53E+01	2.52E+01	2.54E+01	2.53E+01
25 QC	2.31E+01	2.60E+01	2.59E+01	2.64E+01	2.73E+01	2.64E+01
25 QC	2.28E+01	2.57E+01	2.56E+01	2.58E+01	2.68E+01	2.60E+01

Analyst: D.A. Kovacs

Sample BLQ < 1.0 ug/ml

Printed: 10/8/97

CHAIN OF CUSTODY RECORD / ANALYTICAL ~~SERVICES~~ REQUEST

NRMRL

Page 1 of 1

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400
~~FAX RESULTS~~ Y / N

COMPANY Parsons Engineering Science
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290-0900
PHONE# 303-831-8100 FAX #

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D. Fuel Weathering Study
EAL. QUOTE # P.O.#
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day
☐ Other (Specify)
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Dave Seaver - Foster-Wheeler
(print)
~~Evergreen Analytical Cooler No.~~
~~Cooler Received~~

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: ~~Oil / Sludge~~ Free Product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	BTEX + TMBs	Naphthalene & Methylnaphthalenes	Density					EAL Sample No.
WA-CR02	9/18/97	1053	1			X														X	X	X					
BFT-401-3	8/12/97	1030	1			X														X	X	X					
HT:																											Location
DD:																											Container Size

EAL use only
Do not write in shaded area
EAL
Project #
Custodian

Instructions: Fuel Weathering Study - Analyze product only on BFT-401-3
Please perform mass fraction BTEX, TMBs, naphthalene & methylnaphthalenes & Density on Free Product: WA-CR02 fr/ McChord AFB, WA & BFT-401-3 from Beaufort MCAS, SC

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	9/22/97						

MANTECH

Ref: 97-DK21/vg
July 29, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

Myrtle Beach OFFutt, Tank 349
Shaw & DFSP Charleston - Vroblesky

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of methylene chloride soil extracts and "fuel product" samples for Service Request #SF-3-258, Amendment #3. The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2,3-trimethylbenzene (1,2,3-TMB), naphthalene, 2-methylnaphthalene and 1-methylnaphthalene.

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 µl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) plus an SGE 0.3m X 0.53 mm ID deactivated Carbowax deactivated capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 µg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The "floating product" samples were analyzed as 1:40 methylene chloride dilutions except for samples "MW-349-1FP" and "MW-349-6FP" where a 1/400 dilution was also required. Complete reports detailing the acquisition method and calibration curves have been recorded. SIM mode analyses for quantitation of target compounds was performed July 25-26, 1997. Fuel product densities were measured and are recorded on the attached data report.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G.B. Smith

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
Core Samples									
(mg/kg)									
OFSB-1-39'	5.62E-01	3.34E-01	2.91E-01	2.24E-01	4.20E-01	1.47E-01	1.06E-01	2.95E-01	4.40E-02
OFSB-2-39'	1.92E+01	8.32E+01	3.70E+01	2.81E+01	5.87E+01	3.29E+01	1.40E+01	4.56E+01	1.17E+01
OFSB-1-40'	4.02E+01	1.65E+02	5.87E+01	4.80E+01	9.98E+01	5.52E+01	2.23E+01	6.60E+01	1.76E+01
Fuel Product									
(ug/ml)									
MW-349-1FP	8.31E+03	4.00E+04	1.11E+04	9.04E+03	2.33E+04	1.06E+04	4.34E+03	1.48E+04	3.45E+03
MW-349-6FP	9.45E+03	4.06E+04	1.33E+04	9.21E+03	2.35E+04	1.10E+04	4.56E+03	1.57E+04	3.87E+03
W108-DFSP	BLQ	2.10E+01	5.31E+01	5.41E+01	5.00E+01	9.65E+01	5.81E+02	1.60E+03	1.21E+03
WQ27B	2.09E+02	4.54E+01	2.12E+03	1.68E+03	4.62E+03	3.53E+02	1.13E+03	2.67E+03	9.86E+02
JP4-DFSP	1.78E+03	6.65E+03	1.54E+03	1.79E+03	3.80E+03	2.51E+03	2.21E+03	7.72E+03	3.18E+03
Fuel Product									
... mass fraction ...									
(concentration/density)									
MW-349-1FP , d=0.720 g/ml	1.15E-02	5.55E-02	1.55E-02	1.26E-02	3.23E-02	1.47E-02	6.03E-03	2.05E-02	4.79E-03
MW-349-6FP , d=0.722 g/ml	1.31E-02	5.63E-02	1.85E-02	1.28E-02	3.25E-02	1.53E-02	6.32E-03	2.17E-02	5.36E-03
W108-DFSP , d=0.791 g/ml	BLQ	2.65E-05	6.72E-05	6.84E-05	6.32E-05	1.22E-04	7.34E-04	2.03E-03	1.53E-03
WQ27B , d=0.775 g/ml	2.70E-04	5.86E-05	2.73E-03	2.16E-03	5.96E-03	4.55E-04	1.46E-03	3.44E-03	1.27E-03
JP4-DFSP , d=0.730 g/ml	2.44E-03	9.11E-03	2.11E-03	2.45E-03	5.21E-03	3.44E-03	3.02E-03	1.06E-02	4.35E-03
Check Standards									
(ug/ml)									
250	2.49E+02	2.52E+02	2.49E+02	2.51E+02	2.50E+02	2.48E+02	2.48E+02	2.48E+02	2.48E+02
25	2.71E+01	2.67E+01	2.48E+01	2.64E+01	2.64E+01	2.59E+01	2.66E+01	2.43E+01	2.61E+01
25	2.56E+01	2.61E+01	2.46E+01	2.63E+01	2.66E+01	2.64E+01	2.70E+01	2.65E+01	2.64E+01
25	2.36E+01	2.40E+01	2.24E+01	2.36E+01	2.40E+01	2.43E+01	2.48E+01	2.43E+01	2.42E+01
25	2.35E+01	2.32E+01	2.17E+01	2.32E+01	2.32E+01	2.32E+01	2.37E+01	2.33E+01	2.33E+01
2.5	2.65E+00	2.68E+00	2.59E+00	2.59E+00	2.63E+00	2.62E+00	2.53E+00	2.67E+00	2.66E+00
2.5	2.32E+00	2.36E+00	2.29E+00	2.29E+00	2.34E+00	2.37E+00	2.42E+00	2.40E+00	2.36E+00
0.25	2.45E-01	2.67E-01	2.36E-01	2.35E-01	2.48E-01	2.41E-01	2.30E-01	2.45E-01	2.68E-01
Offutt AFB Method Blank	ND	BLQ	ND	BLQ	ND	BLQ	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
QC (expected)	5.00E+01	6.00E+01	6.00E+01	6.00E+01	5.00E+01	6.00E+01	5.00E+01	5.00E+01	5.00E+01
QC (observed)	5.15E+01	6.07E+01	6.27E+01	6.41E+01	5.02E+01	5.92E+01	4.70E+01	4.81E+01	5.29E+01

BLQ<0.025 ug/ml

BQ

	Naphthalene	2-methylnaphthalene	1-methylnaphthalene
Core Samples			
(mg/kg)			
OFSB-1-39'	BLQ	3.15E-02	1.18E-02
OFSB-2-39'	5.51E+00	5.36E+00	2.63E+00
OFSB-1-40'	1.07E+01	1.17E+01	5.59E+00
Fuel Product			
(ug/ml)			
MW-349-1FP	2.17E+03	2.28E+03	1.10E+03
MW-349-6FP	2.08E+03	1.86E+03	9.00E+02
W108-DFSP	7.68E+02	2.62E+03	1.93E+03
WQ27B	1.05E+03	2.09E+03	1.59E+03
JP4-DFSP	1.08E+03	1.87E+03	1.16E+03
Fuel Product			
... mass fraction ...			
(concentration/density)			
MW-349-1FP , d=0.720 g/ml	3.01E-03	3.16E-03	1.52E-03
MW-349-6FP , d=0.722 g/ml	2.88E-03	2.57E-03	1.25E-03
W108-DFSP , d=0.791 g/ml	9.70E-04	3.32E-03	2.44E-03
WQ27B , d=0.775 g/ml	1.35E-03	2.69E-03	2.05E-03
JP4-DFSP , d=0.730 g/ml	1.48E-03	2.56E-03	1.58E-03
Check Standards			
(ug/ml)			
250	2.49E+02	2.48E+02	2.64E+02
25	2.65E+01	2.66E+01	2.78E+01
25	2.68E+01	2.64E+01	2.72E+01
25	2.39E+01	2.45E+01	2.46E+01
25	2.35E+01	2.29E+01	2.35E+01
2.5	2.66E+00	2.64E+00	2.66E+00
2.5	2.35E+00	2.35E+00	2.34E+00
0.25	2.53E-01	2.42E-01	2.51E-01
Offutt AFB Method Blank	ND	ND	ND
Methylene Chloride	ND	ND	ND
QC (expected)	N/A	N/A	N/A
QC (observed)	N/A	N/A	N/A

BLQ<0.025 ug/ml

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 97-LB43
July 14, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

CH-H GW

THRU: Steve Vandegrift SV

Dear Don:

Please find attached the analytical results for Service Request SF-3-258 requesting the analysis of aqueous samples for weathering data to be analyzed for Benzene, Toluene, Ethylbenzene, p-, m-, and o-Xylene, 1,3,5-, 1,2,4-, and 1,2,3-Trimethylbenzene, 1,2,4,5-, 1,2,3,5-, and 1,2,3,4-Tetramethylbenzene, Naphthalene, 2-, and 1-Methyl Naphthalene and Total Fuel Carbon. We received your 2 samples, in duplicate, July 2, 1997 in capped, lead lined 40 mL VOA vials. The samples were analyzed on July 9-10, 1997. Samples were stored at 4°C until analyzed. All samples were acquired and processed using the Millennium data system. A 5 point (1-1000 ppb) external calibration curve was used to determine the concentration for BTEXXXTMBs; a 3 point (10-500) external calibration curve was used to determine the concentration for the TetraMBs and Naphthalenes.

RSKSOP-133 "Simultaneous Analysis of Aromatics and Total Fuel Carbon by Dual Column/Dual Detector Gas Chromatography in Ground Water Samples" was used for these analyses. Autosampling was performed using a Dynatech-Precision autosampler in-line with a Tekmar LSC 2000 sample concentrator.

Sincerely,

Lisa R. Black

Lisa R. Black

xc: R.L. Cosby
G.B. Smith
J.L. Seeley

ManTech Environmental Research Services Corporation
R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

Printed 7/14/97 SF-3-258

Offutt AFB Weathering Data Presented to Dr. Don Kampbell

Units = ng/mL Analyst: L. Black

npleName	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
, OBSERVED, PPB	18.8	19.2	19.0	20.2	19.4	20.1	20.7	20.9	18.4
, TRUE VALUE, PPB	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
PPB	89.8	93.2	96.6	96.1	95.1	94.5	101	99.7	97.1
/ 349-1	35000	42400	4550	3530	8270	5700	845	3230	852
/ 349-6	38440	43860	3990	2870	6780	4650	441	1840	508
PPB	486	492	495	478	474	494	505	507	504

npleName	1,2,4,5-TetraMB	1,2,3,5-TetraMB	1,2,3,4-TetraMB	Naphthalene	2-MethylNaphthalene	1-MethylNaphthalene	Fuel Carbon
PPB	95.8	95.6	96.4	96.6	96.0	95.4	N/A
/ 349-1	59.9	82.1	130	723	158	147	81300
/ 349-6	69.8	95.2	138	449	148	138	81200
PPB	488	488	488	487	475	468	N/A

N/A = Not Analyzed

MANTECH

Ref: 97-DK25/vg
September 12, 1997

Eaker Soil
& Free Product

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift

Dear Dr. Kampbell:

This report contains the results of my GC/MSD analysis of methylene chloride soil extracts and "fuel product" samples from Eaker AFB, for Service Request #SF-3-284. The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene (1,3,5-TMB), 1,2,4-trimethylbenzene (1,2,4-TMB), 1,2,3-trimethylbenzene (1,2,3-TMB), naphthalene, 2-methylnaphthalene (2-MN) and 1-methylnaphthalene (1-MN).

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 µl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5µm film) plus an SGE 0.2m X 0.53 mm ID Carbowax deactivated capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 µg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The "floating product" samples were analyzed as 1:20 and again as 1:40 methylene chloride dilutions. The soil samples were extracted with 10 ml methylene chloride (7 ml additional methylene chloride added to each sample vial) on September 9, 1997, by Mark Blankenship. Complete reports detailing the acquisition method and calibration curves have been recorded. SIM mode analyses for quantitation of target compounds was performed September 9-10, 1997. Fuel product densities were measured and are recorded on the attached data report.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G.B. Smith

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

S.R. SF-3-284 , Dr. Kampbell , Eaker AFB GC/SIM-MS $MeCl_2$ Soil Extract and Fuel Product Units = ug/ml

Sample	Benzene	Toluene	EB	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Naphthalene	2-MN	1-MN
Soil Extracts (ug/g)												
(10ml extract volume)												
EAK SB1-3	1.08E+01	3.90E-02	1.66E+01	2.01E+01	4.37E+01	1.75E+01	1.96E+01	3.62E+01	1.22E+01	4.45E+00	1.17E+01	6.44E+00
EAK SB2-2	ND	ND	2.65E-01	1.93E-01	ND	BLQ	6.92E-01	1.99E+00	6.82E-01	1.91E-01	4.28E-01	5.35E-01
EAK SB2-4	ND	ND	5.40E+00	5.80E+00	8.77E-01	2.72E+00	7.66E+00	1.41E+01	4.09E+00	2.14E+00	6.71E+00	3.74E+00
Fuel Product (ug/ml)												
AEKMW306-FP	2.70E+00	ND	2.48E+03	2.93E+03	5.30E+02	1.69E+03	4.21E+03	7.57E+03	1.95E+03	1.05E+03	3.95E+03	2.15E+03
EAKMW316 -FP	9.00E+02	ND	2.96E+03	4.12E+03	8.88E+03	2.40E+03	4.98E+03	9.61E+03	3.44E+03	1.00E+03	2.90E+03	1.61E+03
Check Standard (ug/ml)												
250	2.44E+02	2.47E+02	2.50E+02	2.51E+02	2.51E+02	2.50E+02	2.54E+02	2.53E+02	2.54E+02	2.52E+02	2.55E+02	2.53E+02
25	2.59E+01	2.57E+01	2.54E+01	2.55E+01	2.61E+01	2.56E+01	2.65E+01	2.50E+01	2.51E+01	2.48E+01	2.43E+01	2.50E+01
2.5	2.51E+00	2.49E+00	2.50E+00	2.48E+00	2.51E+00	2.42E+00	2.48E+00	2.49E+00	2.50E+00	2.47E+00	2.47E+00	2.48E+00
2.5	2.48E+00	2.46E+00	2.42E+00	2.33E+00	2.41E+00	2.36E+00	2.48E+00	2.49E+00	2.50E+00	2.46E+00	2.48E+00	2.45E+00
0.25	2.53E-01	2.57E-01	2.42E-01	2.40E-01	2.50E-01	2.49E-01	2.37E-01	2.42E-01	2.60E-01	2.66E-01	2.65E-01	2.58E-01
0.025	2.47E-02	2.65E-02	2.51E-02	2.40E-02	2.66E-02	2.57E-02	2.73E-02	2.77E-02	2.74E-02	2.78E-02	3.28E-02	3.31E-02
QC Standard (ug/ml)												
25	2.41E+01	2.42E+01	2.41E+01	2.38E+01	2.36E+01	2.41E+01	2.33E+01	2.46E+01	2.46E+01	2.47E+01	2.53E+01	2.52E+01
25	2.53E+01	2.52E+01	2.54E+01	2.60E+01	2.50E+01	2.49E+01	2.39E+01	2.55E+01	2.57E+01	2.55E+01	2.61E+01	2.60E+01
25	2.56E+01	2.59E+01	2.58E+01	2.61E+01	2.53E+01	2.55E+01	2.44E+01	2.59E+01	2.60E+01	2.59E+01	2.66E+01	2.64E+01
$MeCl_2$	ND	BLQ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

The following fuel product density (g/ml) was determined:

AEKMW306-FP	0.7626
EAKMW316 -FP	0.7704

Analyst: D.A. Kovacs BLQ < 0.025 ug/ml Printed: 9/11/97

MANTECH ENVIRONMENTAL TECHNOLOGY

Eaker
Groundwater

Ref: 97-LB61
September 9, 1997

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: Steve Vandegrift SV

Dear Don:

Please find attached the analytical results for the Eaker AFB service request SF-3-284, requesting the analysis of water samples to be analyzed for benzene, toluene, ethylbenzene, p-, m-, and o-xylene, 1,3,5-, 1,2,4-, and 1,2,3-trimethylbenzene, naphthalene, methylnaphthalenes and total fuel carbon. We received your 2 samples, in duplicate, August 29, 1997 in capped, lead lined 40 mL VOA vials. The samples were analyzed on September 5, 1997. Samples were stored at 4°C until analyzed. All samples were acquired and processed using the Millennium data system. A 4 point (1-500 ppb) external calibration curve was used to determine the concentration for all compounds except the naphthalenes, which were quantitated using a 4 point (2-500) external calibration curve.

RSKSOP-133 "Simultaneous Analysis of Aromatics and Total Fuel Carbon by Dual Column/Dual Detector Gas Chromatography in Ground Water Samples" was used for these analyses. Autosampling was performed using a Dynatech-Precision autosampler in-line with a Tekmar LSC 2000 sample concentrator.

Sincerely,

Lisa R. Black

Lisa R. Black

xc: R.L. Cosby
G.B. Smith
J.T. Wilson
J.L. Seeley SV for

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Laboratory, P.O. Box 1198, 919 Research Drive
Ada, Oklahoma 74821-1189 405-436-8660 FAX 405-436-8501

SampleName	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE
100 PPB	93.0	93.3	93.9	94.3	94.0	94.4
EAK MP	*8680	2.7	704	811	1643	253
AEK MP	56.7	2.3	560	708	199	586
QC, OBSERVED, PPB	20.7	20.7	19.0	20.5	20.2	20.9
QC, TRUE VALUE, PPB	20.0	20.0	20.0	20.0	20.0	20.0

SampleName	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	Naphthalene	2-MethylNaph	1-MethylNaph	Fuel Carbon
100 PPB	94.9	94.9	93.9	90.5	87.7	88.3	N/A
EAK MP	314	628	266	131	96.1	67.7	11880
AEK MP	334	571	192	161	181	114	6410
QC, OBSERVED, PPB	20.7	20.8	18.9	48.1	52.1	32.1	N/A
QC, TRUE VALUE, PPB	20.0	20.0	20.0	50.0	50.0	32.0	N/A

* Quantitation based on a 5 point (1-1000) calibration curve.

ND = None Detected; BLQ = Below Limit of Quantitation, 1 ppb; N/A = Not Analyzed

Eaker Fuel Carbon in Soil

Sample ID	Extract conc (ng/ul)	Original conc (ug/g)	Fuel carbon (ug/g)
EAK SB1-3	5070	3680	3130
EAK SB2-2	502	342	291
EAK SB2-4	2720	1890	1610
Method blank	nd		
QC Data			
blank MeCl2	nd		
100 ng/ul JP-4	108		
1000 ng/ul JP-4	926		
10000 ng/ul JP-4	10700		

nd = none detected

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

NRMRL

COMPANY Parsons Engineering Science
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290-0900
PHONE# 303-831-8100 FAX # 303-831-8208

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D.
EAL QUOTE # P.O.#
TURNAROUND REQUIRED* ☐ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify)
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Christopher Papanik
(print) Christopher Papanik
[redacted]
Cooler Received

Please **PRINT** all information:

Spill Site No. 2 Eaker AFB

EAL use only
Do not write in shaded area
EAL
Project #
Custodian

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil/Solid	MATRIX: ~~Oil/Sludge~~ JP-4 Free Product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	BTEX + TMB's	Naphthalene & Methylnaphthalenes	Total Fuel Carbon	Density	EAL Sample No.
AEKMP2-2	27Aug97	1630	2	X																X	X			
AEKMP1-2	"	1550	2	X																X	X			
AEKSB2-2	"	1330	1		X															X	X	X		
AEKSB2-4	"	1400	1		X															X	X	X		
EAKMW316-FP	27Aug97	1220	1			X														X	X		X	
EAKMW306-FP	27Aug97	1240	1			X														X	X		X	
AEKSB1-3	"	0955	1		X															X	X	X		
unused vials	—	—	3																					
Last Item																								
HT:																								Location
DD:																								Container Size

Instructions: Fuel Weathering Study
Samples: Please perform mass fraction BTEX, TMB's, Naphthalene & Methylnaphthalenes & Density ~~on~~ on free product
Analyze groundwater & soil samples as indicated above

[redacted] Relinquished by: (Signature) [redacted] Date/Time [redacted] Received by: (Signature) [redacted] Date/Time [redacted] Relinquished by: (Signature) [redacted] Date/Time Received by: (Signature) [redacted] Date/Time [redacted]

MANAGEMENT TECHNOLOGY

Ref: 98-DK2/ck
March 30, 1998

SHAW 1610
1998

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MS analysis of "floating product" and soil extract samples from Seymore-Johnson AFB (Service Request #SF-4-314) and Shaw AFB (Service Request #SF-4-315). The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, naphthalene, 2-methylnaphthalene and 1-methylnaphthalene.

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 μl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5μm film) plus an SGE 0.1m X 0.53 mm ID deactivated Carbowax capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 μg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The floating product samples were analysed as 1:50 methylene chloride dilutions. Soils samples were extracted with methylene chloride. Complete reports detailing the acquisition method and calibration curves have been recorded. SIM mode analyses for quantitation of the target compounds was performed March 23-25, 1998. Floating product densities were measured and are recorded on the attached data report.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G. Smith

S.R. SF-4-314 (Seymore-Johnson AFB)
S.R. SF-4-315 (Shaw AFB)

GC/SIM-MS Soil Extracts and Floating Product

Originator = Dr. D. Kampbell

Samples	Density	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB
Soil Extracts (ug/g)									
SJ98 SB1-3'	N/A	3.06E+00	1.72E+01	2.43E+01	1.89E+01	5.30E+01	2.96E+01	3.83E+01	1.18E+02
SJ98 SB2-3'	N/A	3.47E+00	3.46E+01	5.41E+01	3.84E+01	1.03E+02	6.70E+01	7.82E+01	2.66E+02
SJ98 SB2-4'	N/A	1.82E+00	2.93E+01	3.99E+01	2.13E+01	6.46E+01	4.16E+01	4.86E+01	2.06E+02
SH98 SB1-27	N/A	3.31E-01	5.51E-01	1.84E+00	1.85E+00	5.11E+00	1.86E+00	4.83E+00	1.15E+01
SH98 SB2-27	N/A	3.94E-01	3.35E-01	3.90E+00	4.43E+00	1.25E+01	7.18E+00	7.80E+00	2.47E+01
Floating Product (ug/ml)	(g/ml)								
SJ98 MP2	0.812	4.89E+01	6.38E+02	8.50E+02	5.92E+02	1.51E+03	1.11E+03	1.15E+03	4.38E+03
SJ98 MW12S	0.818	4.72E+01	6.02E+02	8.00E+02	5.80E+02	1.42E+03	1.04E+03	1.09E+03	4.19E+03
SH98 1610-2	0.78	1.25E+03	2.83E+03	1.04E+03	1.31E+03	3.44E+03	2.43E+03	2.20E+03	7.32E+03
SH98 1610-3	0.777	1.65E+03	3.29E+03	1.07E+03	1.29E+03	3.47E+03	2.45E+03	2.01E+03	6.69E+03
Check Standards (ug/ml)									
250	N/A	2.27E+02	2.27E+02	2.28E+02	2.36E+02	2.26E+02	2.27E+02	2.28E+02	2.28E+02
25	N/A	2.51E+01	2.51E+01	2.50E+01	2.50E+01	2.52E+01	2.53E+01	2.51E+01	2.55E+01
2.5	N/A	2.69E+00	2.84E+00	2.62E+00	2.62E+00	2.58E+00	2.60E+00	2.62E+00	2.60E+00
2.5	N/A	2.34E+00	2.18E+00	2.37E+00	2.40E+00	2.33E+00	2.35E+00	2.37E+00	2.38E+00
2.5	N/A	2.50E+00	2.54E+00	2.52E+00	2.56E+00	2.54E+00	2.53E+00	2.49E+00	2.48E+00
0.25	N/A	2.77E-01	2.71E-01	2.74E-01	2.82E-01	2.77E-01	2.79E-01	2.73E-01	2.68E-01
0.25	N/A	2.23E-01	2.29E-01	2.26E-01	2.30E-01	2.23E-01	2.21E-01	2.27E-01	2.32E-01
0.025	N/A	2.50E-02	2.48E-02	2.50E-02	2.50E-02	2.50E-02	2.53E-02	2.50E-02	2.50E-02
Extract Trip Blank	N/A	ND	ND	ND	ND	ND	ND	ND	ND
25 QC	N/A	2.49E+01	2.50E+01	2.47E+01	2.57E+01	2.41E+01	2.46E+01	2.29E+01	2.55E+01

Analyst: D. A. Kovacs

BLQ < 0.025 ug/ml

Samples	1,2,3-TMB	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene
Soil Extracts (ug/g)				
SJ98 SB1-3'	6.04E+01	2.70E+01	5.25E+01	3.50E+01
SJ98 SB2-3'	1.48E+02	5.95E+01	1.28E+02	8.78E+01
SJ98 SB2-4'	9.81E+01	3.76E+01	8.72E+01	6.04E+01
SH98 SB1-27	3.38E+00	2.22E-01	1.50E+00	7.89E-01
SH98 SB2-27	1.03E+01	3.33E+00	7.11E+00	4.42E+00
Floating Product (ug/ml)				
SJ98 MP2	2.33E+03	8.79E+02	1.90E+03	1.29E+03
SJ98 MW15 S	2.24E+03	8.44E+02	1.83E+03	1.25E+03
SH98 1610-2	3.13E+03	1.32E+03	2.20E+03	1.32E+03
SH98 1610-3	2.86E+03	1.23E+03	1.98E+03	1.20E+03
Check Standards (ug/ml)				
250	2.28E+02	2.28E+02	2.30E+02	2.26E+02
25	2.55E+01	2.57E+01	2.55E+01	2.57E+01
2.5	2.61E+00	2.61E+00	2.59E+00	2.58E+00
2.5	2.38E+00	2.38E+00	2.39E+00	2.37E+00
2.5	2.49E+00	2.49E+00	2.50E+00	2.50E+00
0.25	2.69E-01	2.69E-01	2.64E-01	2.80E-01
0.25	2.30E-01	2.31E-01	2.34E-01	2.20E-01
0.025	2.50E-02	2.50E-02	2.57E-02	2.66E-02
Extract Trip Blank	ND	ND	ND	ND
25 QC	2.56E+01	2.61E+01	2.72E+01	2.66E+01

SF-4-315 / Kampbell / Shaw AFB / TPH Analyses

	Sample ID	Extract conc (ng/ul)	Original conc (ug/g)	Fuel carbon (ug/g)
	Method blank	blq		
SH98	SB1-27	11400	3010	2560
SH98	SB2-27	11800	3110	2640
SJ98	SB1-3' (1:10)	61600	16200	13800
SJ98	SB2-3' (1:10)	67300	24800	21100
SJ98	SB2-4' (1:10)	103000	27200	23100
		QC Data		
	blank MeCl2	nd		
	500 ng/ul JP-4	485		
	5000 ng/ul JP-4	5090		
	50000 ng/ul JP-4	49200		

nd = none detected

blq = below limit of quantitation (<500 ng/ul JP-4 detected in extract)

RESULTS ARE CORRECTED FOR THE INDICATED DILUTION FACTORS

Printed 04\09\98 SF-4-315 — Analyses for Dr. Kampbell — Units = ng/ml Analyst M. Blankenship

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE
GC LAB BLANK	ND	ND	.ND	ND	ND	ND
QC, OBSERVED, 20 PPB	26.7	21.9	18.9	19.9	20.8	20.6
QC, TRUE VALUE, 20 PPB	20.0	20.0	20.0	20.0	20.0	20.0
MP-1 5J98	833.0	2896	587.0	435.0	1296	760.8
MW1610-2 5H98	1557	2712	341.9	426.8	1300	1052
MW1610-3 5H98	1425	1171	259.5	312.3	968.8	790.9
500 PPB STD	432.7	484.1	438.7	434.2	444.0	469.7

SAMPLE NAME	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	NAPHTHALENE	2-METHYLNAPHTHALENE	1-METHYLNAPHTHALENE	FUEL CARBON
GC LAB BLANK	ND	ND	ND	ND	ND	ND	N\A
QC, OBSERVED, 20 PPB	18.6	21.3	17.5	N\A	N\A	N\A	N\A
QC, TRUE VALUE, 20 PPB	20.0	20.0	20.0	N\A	N\A	N\A	N\A
MP-1	133.0	697.3	383.5	247.1	142.2	109.7	10064
MW1610-2	276.4	1026	534.6	395.6	212.9	150.2	11056
MW1610-3	196.2	728.1	399.5	318.6	195.9	138.8	7992
500 PPB STD	417.2	424.7	462.8	434.4	420.2	430.9	N\A

ND = None Detected, N\A = Not Analyzed

MANAGEMENT TECHNOLOGY

Ref: 98-DK2/ck
March 30, 1998

SEYMOUR JOHNSON
B/4522
1998

Dr. Don Kampbell
National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SV

Dear Dr. Kampbell:

This report contains the results of my GC/MS analysis of "floating product" and soil extract samples from Seymore-Johnson AFB (Service Request #SF-4-314) and Shaw AFB (Service Request #SF-4-315). The following compounds were quantitated: benzene, toluene, ethylbenzene, p-xylene, m-xylene, o-xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, naphthalene, 2-methylnaphthalene and 1-methylnaphthalene.

The analytical method was a modification of RSKSOP-124. Cool on-column injection (0.1 μl) was used with electronic pressure control set for a constant flow of 1.0 ml/min. The capillary GC column consisted of a 30m X 0.25mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5μm film) plus an SGE 0.1m X 0.53 mm ID deactivated Carbowax capillary precolumn. SIM mode GC/MSD was used with the ions chosen from those listed in EPA method 524.2 Revision 3.0, where available. Multiple ions were acquired and ion ratios used to verify the accuracy of target compound identification. Standards calibration ranged from 0.025 to 250 μg/ml and was divided into a low level (0.025 to 2.5 ug/ml) and high level (2.5 to 250 ug/ml) curve for improved quantitative accuracy. The floating product samples were analysed as 1:50 methylene chloride dilutions. Soils samples were extracted with methylene chloride. Complete reports detailing the acquisition method and calibration curves have been recorded. SIM mode analyses for quantitation of the target compounds was performed March 23-25, 1998. Floating product densities were measured and are recorded on the attached data report.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G. Smith

Samples	Density	Benzene	Toluene	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	1,3,5-TMB	1,2,4-TMB
Soil Extracts (ug/g)									
SJ98 SB1-3'	N/A	3.06E+00	1.72E+01	2.43E+01	1.89E+01	5.30E+01	2.96E+01	3.83E+01	1.18E+02
SJ98 SB2-3'	N/A	3.47E+00	3.46E+01	5.41E+01	3.84E+01	1.03E+02	6.70E+01	7.82E+01	2.66E+02
SJ98 SB2-4'	N/A	1.82E+00	2.93E+01	3.99E+01	2.13E+01	6.46E+01	4.16E+01	4.86E+01	2.06E+02
SH98 SB1-27	N/A	3.31E-01	5.51E-01	1.84E+00	1.85E+00	5.11E+00	1.86E+00	4.83E+00	1.15E+01
SH98 SB2-27	N/A	3.94E-01	3.35E-01	3.90E+00	4.43E+00	1.25E+01	7.18E+00	7.80E+00	2.47E+01
Floating Product (ug/ml)	(g/ml)								
SJ98 MP2	0.812	4.89E+01	6.38E+02	8.50E+02	5.92E+02	1.51E+03	1.11E+03	1.15E+03	4.38E+03
SJ98 MW12S	0.818	4.72E+01	6.02E+02	8.00E+02	5.80E+02	1.42E+03	1.04E+03	1.09E+03	4.19E+03
SH98 1610-2	0.78	1.25E+03	2.83E+03	1.04E+03	1.31E+03	3.44E+03	2.43E+03	2.20E+03	7.32E+03
SH98 1610-3	0.777	1.65E+03	3.29E+03	1.07E+03	1.29E+03	3.47E+03	2.45E+03	2.01E+03	6.69E+03
Check Standards (ug/ml)									
250	N/A	2.27E+02	2.27E+02	2.28E+02	2.36E+02	2.26E+02	2.27E+02	2.28E+02	2.28E+02
25	N/A	2.51E+01	2.51E+01	2.50E+01	2.50E+01	2.52E+01	2.53E+01	2.51E+01	2.55E+01
2.5	N/A	2.69E+00	2.84E+00	2.62E+00	2.62E+00	2.58E+00	2.60E+00	2.62E+00	2.60E+00
2.5	N/A	2.34E+00	2.18E+00	2.37E+00	2.40E+00	2.33E+00	2.35E+00	2.37E+00	2.38E+00
2.5	N/A	2.50E+00	2.54E+00	2.52E+00	2.56E+00	2.54E+00	2.53E+00	2.49E+00	2.48E+00
0.25	N/A	2.77E-01	2.71E-01	2.74E-01	2.82E-01	2.77E-01	2.79E-01	2.73E-01	2.68E-01
0.25	N/A	2.23E-01	2.29E-01	2.26E-01	2.30E-01	2.23E-01	2.21E-01	2.27E-01	2.32E-01
0.025	N/A	2.50E-02	2.48E-02	2.50E-02	2.50E-02	2.50E-02	2.53E-02	2.50E-02	2.50E-02
Extract Trip Blank	N/A	ND	ND	ND	ND	ND	ND	ND	ND
25 QC	N/A	2.49E+01	2.50E+01	2.47E+01	2.57E+01	2.41E+01	2.46E+01	2.29E+01	2.55E+01

Samples	1,2,3-TMB	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene
Soil Extracts (ug/g)				
SJ98 SB1-3'	6.04E+01	2.70E+01	5.25E+01	3.50E+01
SJ98 SB2-3'	1.48E+02	5.95E+01	1.28E+02	8.78E+01
SJ98 SB2-4'	9.81E+01	3.76E+01	8.72E+01	6.04E+01
SH98 SB1-27	3.38E+00	2.22E-01	1.50E+00	7.89E-01
SH98 SB2-27	1.03E+01	3.33E+00	7.11E+00	4.42E+00
Floating Product (ug/ml)				
SJ98 MP2	2.33E+03	8.79E+02	1.90E+03	1.29E+03
SJ98 MW1~~3~~ 5	2.24E+03	8.44E+02	1.83E+03	1.25E+03
SH98 1610-2	3.13E+03	1.32E+03	2.20E+03	1.32E+03
SH98 1610-3	2.86E+03	1.23E+03	1.98E+03	1.20E+03
Check Standards (ug/ml)				
250	2.28E+02	2.28E+02	2.30E+02	2.26E+02
25	2.55E+01	2.57E+01	2.55E+01	2.57E+01
2.5	2.61E+00	2.61E+00	2.59E+00	2.58E+00
2.5	2.38E+00	2.38E+00	2.39E+00	2.37E+00
2.5	2.49E+00	2.49E+00	2.50E+00	2.50E+00
0.25	2.69E-01	2.69E-01	2.64E-01	2.80E-01
0.25	2.30E-01	2.31E-01	2.34E-01	2.20E-01
0.025	2.50E-02	2.50E-02	2.57E-02	2.66E-02
Extract Trip Blank	ND	ND	ND	ND
25 QC	2.56E+01	2.61E+01	2.72E+01	2.66E+01

	Sample ID	Extract conc (ng/ul)	Original conc (ug/g)	Fuel carbon (ug/g)
	Method blank	blq		
SH98	SB1-27	11400	3010	2560
SH98	SB2-27	11800	3110	2640
SJ98	SB1-3' (1:10)	61600	16200	13800
SJ98	SB2-3' (1:10)	67300	24800	21100
SJ98	SB2-4' (1:10)	103000	27200	23100
	QC Data			
	blank MeCl2	nd		
	500 ng/ul JP-4	485		
	5000 ng/ul JP-4	5090		
	50000 ng/ul JP-4	49200		

nd = none detected
blq = below limit of quantitation (<500 ng/ul JP-4 detected in extract)
RESULTS ARE CORRECTED FOR THE INDICATED DILUTION FACTORS

Printed 04\09\98 SF-4-315 Analyses for Dr. Kampbell Units = ng/ml Analyst M. Blankenship

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE
GC LAB BLANK	ND	ND	ND	ND	ND	ND
QC, OBSERVED, 20 PPB	26.7	21.9	18.9	19.9	20.8	20.6
QC, TRUE VALUE, 20 PPB	20.0	20.0	20.0	20.0	20.0	20.0
MP-1 5J98	833.0	2896	587.0	435.0	1296	760.8
MW1610-2 5H98	1557	2712	341.9	426.8	1300	1052
MW1610-3 5H98	1425	1171	259.5	312.3	968.8	790.9
500 PPB STD	432.7	484.1	438.7	434.2	444.0	469.7

SAMPLE NAME	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	NAPHTHALENE	2-METHYLNAPHTHALENE	1-METHYLNAPHTHALENE	FUEL CARBON
GC LAB BLANK	ND	ND	ND	ND	ND	ND	N\A
QC, OBSERVED, 20 PPB	18.6	21.3	17.5	N\A	N\A	N\A	N\A
QC, TRUE VALUE, 20 PPB	20.0	20.0	20.0	N\A	N\A	N\A	N\A
MP-1	183.0	697.3	383.5	247.1	142.2	109.7	10064
MW1610-2	276.4	1026	534.6	395.6	212.9	150.2	11056
MW1610-3	196.2	728.1	399.5	318.6	195.9	138.8	7992
500 PPB STD	417.2	424.7	462.8	434.4	420.2	430.9	N\A

ND = None Detected, N\A = Not Analyzed

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

Evergreen Analytical Inc. NRMRL

~~4036 Youngfield St.~~
~~Wheat Ridge, Colorado 80033~~
~~(303) 425-6021~~
~~FAX (303) 425-6854~~
~~(800) 845-7400~~

Report Results by:________ (Date)*
Standard 2 working weeks ☐
3 day UST Analyses per Fee Schedule ☐
* Rush: ☐ < 24 hrs ☐ 1 - 2 work days ☐ 3 - 5 work days ☐ 6 - 9 work days
*Rush analysis subject to additional fee

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX# 303-831-8208
REPORT TO (Mr/Ms) Craig Snyder
INVOICE TO
PROJECT I.D. Fuel Weathering
P.O. # EAL QUOTE #
Sampler Name:
(print) Craig B. Snyder
(signature) Craig B. Snyder

Please **PRINT** all information:

SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: ~~Oil / Sludge / Multi-phase~~ Free product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen 8080 mod.	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	TMB's	Naphthalene & Methylnaphthalenes	Density				For Laboratory use only
SJ98MW1S	3/10/98		1			X								X							X	X	X				
SH981610-2	3/11/98		1			X								X							X	X	X				
SH981610-3	3/11/98		1			X								X							X	X	X				
Sample Fraction																											Loc
Container																											

For Laboratory use only: W.O. # / B.O.F. # / C/S (O) / C/S (I) / Cooler Temp. °C / Seals Intact Y / N / NA / Samples Pres. Y / N / NA / Headspace Y / N / NA / By

Instructions:
SH = Shaw AFB Bldg 1610; SJ = Seymour Johnson AFB Bldg 4522
Groundwater & Soil samples shipped separately

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	3/11/98 1720						

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

~~Evergreen Analytical~~ Inc.

~~4036 Youngfield St.~~
~~Wheat Ridge, Colorado~~ 80033
(303) ~~425-6021~~
FAX (303) 425-6854
(800) ~~845-7400~~

NRMRL #2

Report Results by: ____________ (Date)*
Standard 2 working weeks ☐
3 day UST Analyses per Fee Schedule ☐
*Rush: ☐ < 24 hrs ☐ 1 - 2 work days
☐ 3 - 5 work days ☐ 6 - 9 work days
*Rush analysis subject to additional fee

Free Product provided in separate shipment 3 samples

COMPANY Parsons ES
ADDRESS 1700 Broadway Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX# 303-831-8208
REPORT TO (Mr/Ms) Craig Snyder
INVOICE TO
PROJECT I.D. Fuel Weathering
P.O. # ______ EAL QUOTE # ______
Sampler Name:
(print) Craig B. Snyder
(signature) Craig B. Snyder

Please **PRINT** all information:

SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	Water-Drinking/Discharge/Ground (circle)	Soil / Solid / Air / Gas	~~Oil / Sludge / Multi-phase~~ Free Product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen 8080 mod.	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	Total Fuel Carbon	TMBs	Naphthalenes & Methnaps	Density		
SJ98 SB1-3	3/10/98		1		X									X							X	X	X			
SJ98 SB2-3	3/10/98		1		X									X							X	X	X			
SJ98 SB2-4	3/10/98		1		X									X							X	X	X			
SH98 SB1-27	3/11/98		1		X									X							X	X	X			
SH98 SB2-27	3/11/98		1		X									X							X	X	X			
SJ98 MP1	3/10/98		1	X										X							X	X	X			
SH98 MW1610-2	3/11/98			X										X							X	X	X			
SH98 MW1610-3	3/11/98			X										X							X	X	X			
SJ98 MP2	3/10/98					X								X								X	X	X		

Sample Fraction
Container

For Laboratory use only
W.O. #
B.O.F. #
C/S (o)
C/S (i)
Cooler Temp. °C
Seals Intact Y / N / NA
Samples Pres. Y / N / NA
Headspace Y / N / NA
By
LOC

Instructions:

*Please note: SJ98 MP2 is a FREE PRODUCT SAMPLE accidentally collected in GW bottle w/ NaPO4
* Also 2 unused soil vials provided for tare correction - ~~These be~~ All soil bottles preservative is approx 10 mos. old

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	3/11/98 1740						

November 8, 1998

Don,

Here are my target compound and density data for the two Offutt AFB floating fuel product samples you needed ASAP, under SF-0-29. Units are density = g/ml; targets = ug/ml; Limit of detection = 1 ug/ml floating product. Samples were diluted 1:40 and 1:400 prior to analysis with methylene chloride. Analysis by GC/SIM-MSD.

	MW349-1	MW349-6
Density	0.728	0.744
MTBE	None Detected	None Detected
Benzene	7400	2600
Toluene	35000	25640
Ethylbenzene	11840	10120
p-Xylene	9360	9520
m-Xylene	23360	23720
o-Xylene	11720	11840
1,3,5-Trimethylbenzene	4600	5560
1,2,4-Trimetylbenzene	12560	15640
1,2,3-Trimethylbenzene	3120	3880
Naphthalene	2000	1920
2-Methylnaphthalene	2040	1960
1-Methylnaphthalene	920	880

A formal report will follow.

Dave Kovacs DAK, 11/8/98

Fuel carbon later

Don Kampbell

B-2

EAL DATA

Evergreen
Analytical
Laboratory

March 18, 1997

MR CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY SUITE 900
DENVER, CO 80290

Work Order: 97-0751
Client Project ID: Fuel Weathering Study

Dear Mr. Snyder:

Enclosed are the analytical results for the samples shown in theWork Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Patty McClellan, Program Manager.

Upon completion of all required analyses and acceptance of the data report by PES (within 3 weeks of final data package deliver), EAL will be responsible for proper disposal of any remaining samples, sample containers, shipping containers, and Sytrofoam or plastic packing materails in accordance with sound environmental practices, based on the sample analytical results. However, EAL will give prior notification to and receive the approval of PES before disposing of any remaining samples. EAL will maintain proper records of waste disposal methods and disposal methods and disposal company contracts on file for inspection.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Patty McClellan

Jack Barney for
President

Evergreen
Analytical
Laboratory

CASE NARRATIVE

Evergreen Analytical Laboratory (EAL) Project: 97-0751

Parsons Engineering Science, Inc. (PES) Project: Fuel Weathering Study
Myrtle Beach AFB
Shaw AFB

Sample Receipt

On March 7, 1997, two JP-4 fuel samples were received at EAL for analysis under a Fuel Weathering Study project. Refer to the check-in portion of the EAL chain-of-custody for specific information regarding the condition of samples upon receipt. Refer to the EAL Work Order Summary for log-in information and cross-reference of EAL and PES sample identifications.

Fuel/Water Partitioning

Both samples were prepared in accordance with the Cline et al study provided to EAL by PES. A brief description of the procedure is enclosed as well as a copy of the analysts notes of sample prep.

BTEX by Method SW-846 8020

Both phases of each sample were analyzed within holding time. Craig Snyder of PES was notified on 3/13/97 that EAL was unable to separate the benzene portion of the fuel from sample MBMW-8I. There appears to be an interfering compound which co-elutes with the benzene. In the aqueous phase however, the benzene has no interferences.

The EAL Vice President of Quality Assurance, Carl Smits, was consulted for advise as to what the interfering compound may be. He feels it is a C7 olefin, with a boiling point around 180°F such as 2,4-dimethyl pentene-2. This compound is insoluble in water.

I pulled up some data from previous samples submitted for BTEX analysis on free product samples from Parsons - AFCEE sites. Enclosed is a spreadsheet of this data for your review.

Patty McClellan

Patty McClellan, Program Manager
3/18/97

Evergreen Analytical, Inc. 4036 Youngfield St. Wheat Ridge, CO 80033-3862 (303) 425-6021 FAX (303) 425-6854

PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

February 28, 1997

Ms. Patty McClellan
Evergreen Analytical, Inc.
4036 Youngfield
Wheat Ridge, CO 80033

Subject: Fuel/Water Partitioning Analyses for AFCEE Fuel Weathering Study

Dear Ms. McClellan:

The purpose of this letter is to explain the analyses requested from Evergreen Analytical Inc. (Evergreen) to support the Air Force Center for Environmental Excellence (AFCEE) Fuel Weathering study being performed by Parsons Engineering Science, Inc. (Parsons ES). The primary objective of the study is to determine an average range of natural weathering (degradation) rates for fuels released to the subsurface environment. A secondary objective is to determine fuel/water partition coefficients (K_{fw}) at equilibrium saturations. We are hopeful that Evergreen can support us in evaluating fuel/water partitioning.

Determination of K_{fw}'s for gasoline/water mixtures was performed by Cline et al (1991) (see attached). For their study, saturated, equilibrium solutions of gasolines in contact with distilled, deionized, organic-free water were prepared. Two milliliters (mL) of fuel were added to 40 mL of water in VOA vials having Teflon-septa (a 1:20 fuel to water ratio). Samples were mixed on a rotating disk apparatus for 30 minutes at $22 \pm 1°C$. The vials were then allowed to sit undisturbed for 1 hour in an inverted position. From each VOA bottle, the separated water phase was removed through the septum at the bottom of the VOA bottle using a 5-mL syringe. The extracted water phase was then stored in 2-mL crimp seal vials and refrigerated until gas chromatography with flame ionization detection (GC/FID) could be performed.

We wish to follow the same basic procedures as the Cline et al study; however, we would like for both the aqueous phase and the organic (fuel) phase to be analyzed individually following the 30 minute rotation and 1 hour inverted stabilization. We request that each phase be analyzed for determination of benzene, toluene, ethylbenzene, and total xylenes (BTEX) concentrations by USEPA SW8020 by gas chromatography with photoionization detection (GC/PID). Concentrations should be reported in milligrams per liter (mg/L). Our fuel weathering study will look at a variety of fuels (JP-4, JP-5, JP-8 jet fuels and gasoline) collected from ten separate sites. We anticipate submitting to Evergreen either one or two fuel samples per site with one duplicate being submitted for every five sites sampled. We understand that the cost for analysis will be $60.00 for the aqueous phase and $85.00 for the organic phase. Depending upon whether one or two samples are submitted per site, we anticipate that between 12 and 22 fuel samples total will be sent to Evergreen for analysis as part of the study.

We also are submitting fuel samples to the USEPA National Risk Management Research Laboratory (NRMRL) in Ada, Oklahoma and to the Arthur D. Little Laboratory in Cambridge, Massachusetts for other fuel analyses. If possible, we would like to obtain from Evergreen approximately 36 20-mL VOA bottles to support sample collection and submission to the various labs.

At present, seven sites have been selected for the study. During the week of March 3, 1997, we will be collecting samples from the first two sites and anticipate sending to Evergreen two to five fuel samples for analysis as described above. Sampling of the other five sites is likely to occur during one or two separate mobilizations during the Spring/early Summer of 1997. Hopefully, we will be able to identify three other sites to include in the study and sample later this year.

The analytical procedures we have described above are subject to change following review of this letter and the attachment by Evergreen and by Mr. Doug Downey, our Technical Director for the study. Next week, we will have to confirm with you the exact procedures to be followed before analyzing the first round of samples. If you have any questions or comments, please feel free to contact me at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Craig B. Snyder

Craig B. Snyder
Task Manager

Enclosures

cc: D. Downey
D. Moutoux
M. Vessely
File

022/726876/EALMEMO.DOC

Evergreen Analytical, Inc.

97-0751

WORK ORDER Summary

07-Mar-97

Client Project ID: Fuel Weathering Study

Report To: Craig Snyder
Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments:

QC Level: STD

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
97-0751-01A	MBMW-8I	BTEX		Jet Fuel	10	04-Mar-97	07-Mar-97	21-Mar-97	18-Mar-97
97-0751-02A	SHMW1610-2	BTEX				06-Mar-97		21-Mar-97	20-Mar-97

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

MYA 3/7 pm

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D. Fuel Weathering Study
EAL. QUOTE # ____ P.O.# 729691.35730
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B Snyder
Evergreen Analytical Cooler No.____
Cooler Received____

Free Product
Myrtle Beach AFB & Shaw AFB

Please **PRINT** all information:

EAL use only
Do not write in shaded area

WO# 97-0751 BOF# NA BY KB
C/S(o) NA / NA C/S(I) C / CO
Temp°C 8 Seals Intact Y/N/NA
Pres Y/N/NA Hd Sp Y/N/NA
Loc 10 Cont 20V

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: ~~Oil / Sludge~~ JP-4 Jet Fuel	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	EAL Sample No.
MBMW-8I	3/4/97	1500	~~X~~ 1			X								X						
CBD ~~MBMW-24~~	~~3/4/97~~	~~1645~~	~~1~~			~~X~~								~~X~~						
SHMW1610-2	3/6/97	0800	1			X								X						
HT:																				Location
DD:																				Container Size

Instructions: Analyze - IAW Feb 28, 1997 letter from Parsons ES to Patty McClellan - Organic & Aqueous Phases - B

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[redacted]	[redacted]	[redacted]	3/7/97 [redacted]	[redacted]	[redacted]	[redacted]	[redacted]

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MBMW-8I	Client Project No.	: FUEL WEATHERING STUDY
Lab Sample Number	: 97-0751-01	Lab Work Order	: 97-0751
Date Sampled	: 3/4/97	Matrix	: FUEL PORTION*
Date Received	: 3/7/97	Lab File Number(s)	: TVB10310070
Date Prepared	: 3/11/97	Method Blank	: FMB031197
FID Dilution Factor	: 250,000		
PID Dilution Factor	: 250,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/12/97	U#	4,000,000	ug/L
Toluene	108-88-3	3/12/97	U#	1,000,000	ug/L
Ethyl Benzene	100-41-4	3/12/97	1,830,000	1,000,000	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/12/97	6,210,000	1,000,000	ug/L
o-Xylene	95-47-6	3/12/97	153,000 J	1,000,000	ug/L
FID Surrogate Recovery:		NA		50%-150%	(Limits)
PID Surrogate Recovery:		126%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

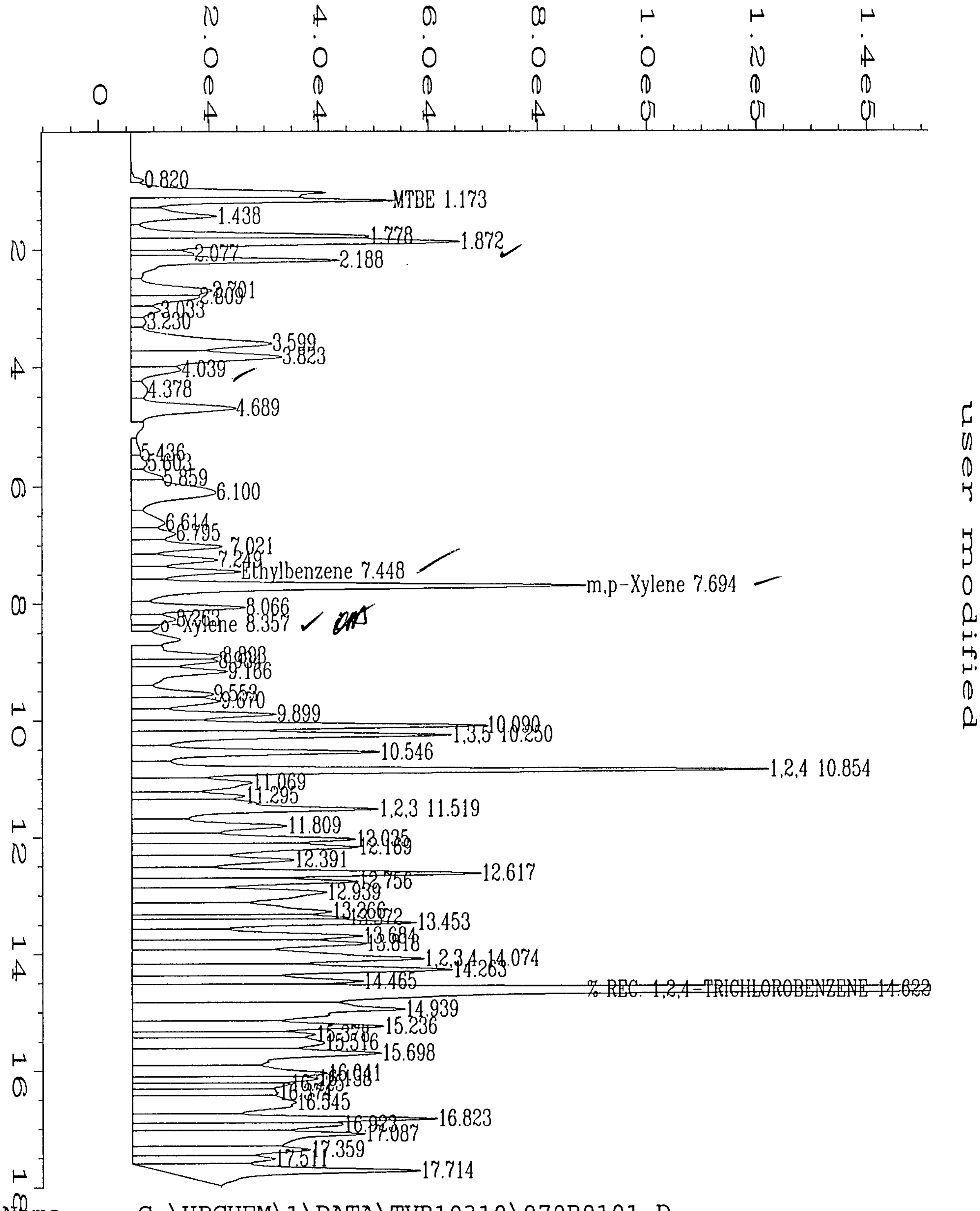
Comments: * = of Fuel Weathering Study; # = Interfering peaks making quantitation difficult.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

WH
Analyst

EMcClelland
Approved



Data File Name	: C:\HPCHEM\1\DATA\TVB10310\070R0101.D		
Operator	: H. Diane Mills	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 70
Sample Name	: 97-0751-01A-FU	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 1
Acquired on	: 12 Mar 97 09:22 PM	Instrument Method:	TVH11216.MTH
Report Created on:	13 Mar 97 09:41 AM	Analysis Method	: BX10310.MTH
Last Recalib on	: 11 MAR 97 10:15 AM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:

DF = 250,000
MB MW-8I; 2.0ul of 1/100 ext (fuel portion)

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MBMW-8I	Client Project No.	: FUEL WEATHERING STUDY
Lab Sample Number	: 97-0751-01	Lab Work Order	: 97-0751
Date Sampled	: 3/4/97	Matrix	: AQEUOUS PORTION*
Date Received	: 3/7/97	Lab File Number(s)	: TVB10310063
Date Prepared	: 3/11/97	Method Blank	: FMB031197
FID Dilution Factor	: 25		
PID Dilution Factor	: 25		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/12/97	1040	10	ug/L
Toluene	108-88-3	3/12/97	U	10	ug/L
Ethyl Benzene	100-41-4	3/12/97	515	10	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/12/97	1740	10	ug/L
o-Xylene	95-47-6	3/12/97	11	10	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		100%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = of Fuel Weathering Study

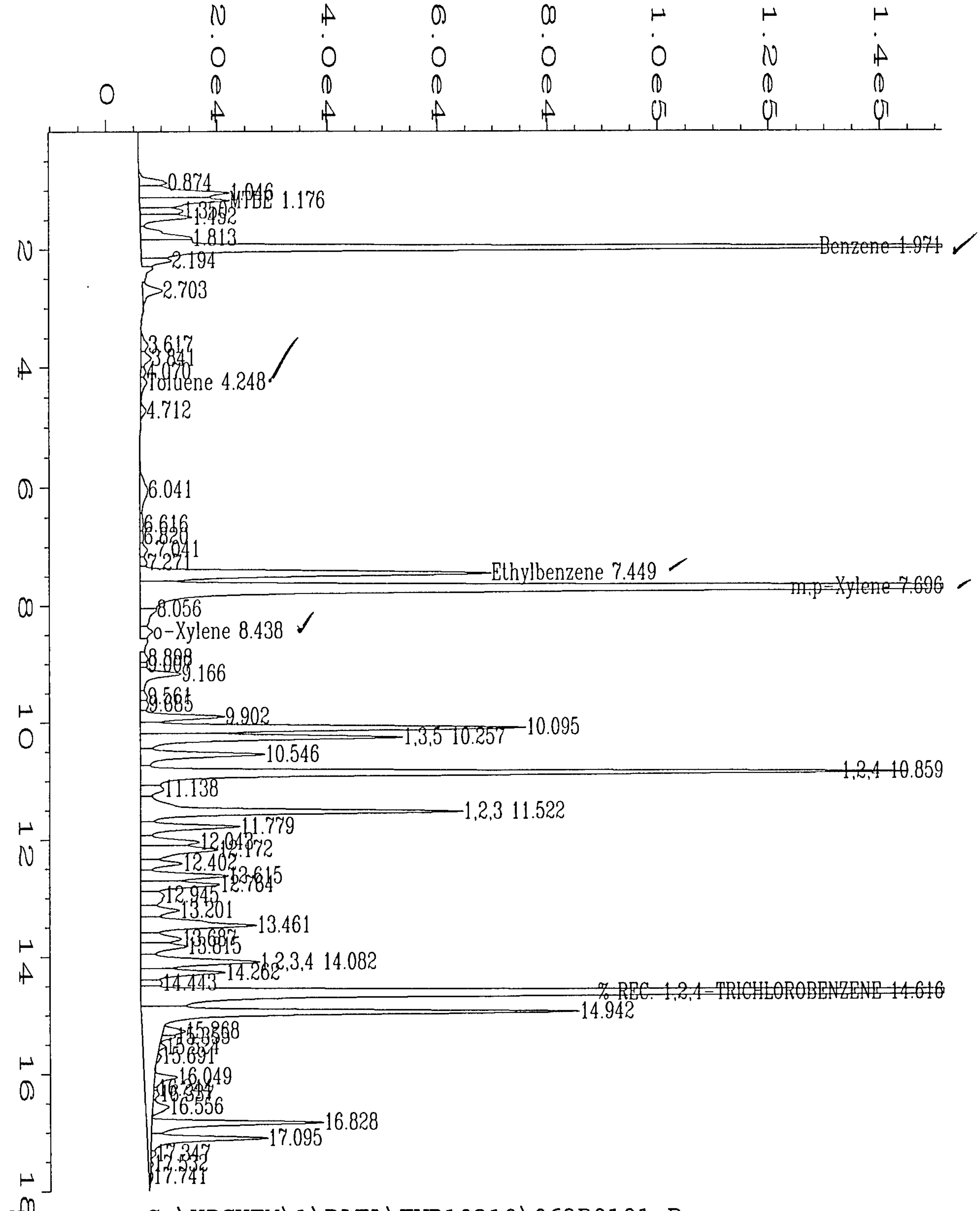
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved

TVBXWS1;TVBF0751.XLS; 3/17/97; 2



Data File Name : C:\HPCHEM\1\DATA\TVB10310\063R0101.D
Operator : H. Diane Mills
Instrument : TVHBTEX1
Sample Name : 97-0751-01A-AQ
Run Time Bar Code:
Acquired on : 12 Mar 97 05:22 PM
Report Created on: 12 Mar 97 05:48 PM
Last Recalib on : 11 MAR 97 10:15 AM
Multiplier DF : 25
Sample Info : SAMP BTEX_O
::MBMW-8I; 200 UL AQUEOUS PART OF EXTRACT

Page Number : 1
Vial Number : 63
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10310.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: SHMW1610-2	Client Project No.	: FUEL WEATHERING STUDY
Lab Sample Number	: 97-0751-02	Lab Work Order	: 97-0751
Date Sampled	: 3/6/97	Matrix	: FUEL PORTION*
Date Received	: 3/7/97	Lab File Number(s)	: TVB10310060
Date Prepared	: 3/11/97	Method Blank	: FMB031197
FID Dilution Factor	: 250,000		
PID Dilution Factor	: 250,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/12/97	2,650,000	1,000,000	ug/L
Toluene	108-88-3	3/12/97	5,740,000	1,000,000	ug/L
Ethyl Benzene	100-41-4	3/12/97	1,770,000	1,000,000	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/12/97	7,490,000	1,000,000	ug/L
o-Xylene	95-47-6	3/12/97	3,490,000	1,000,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		120%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

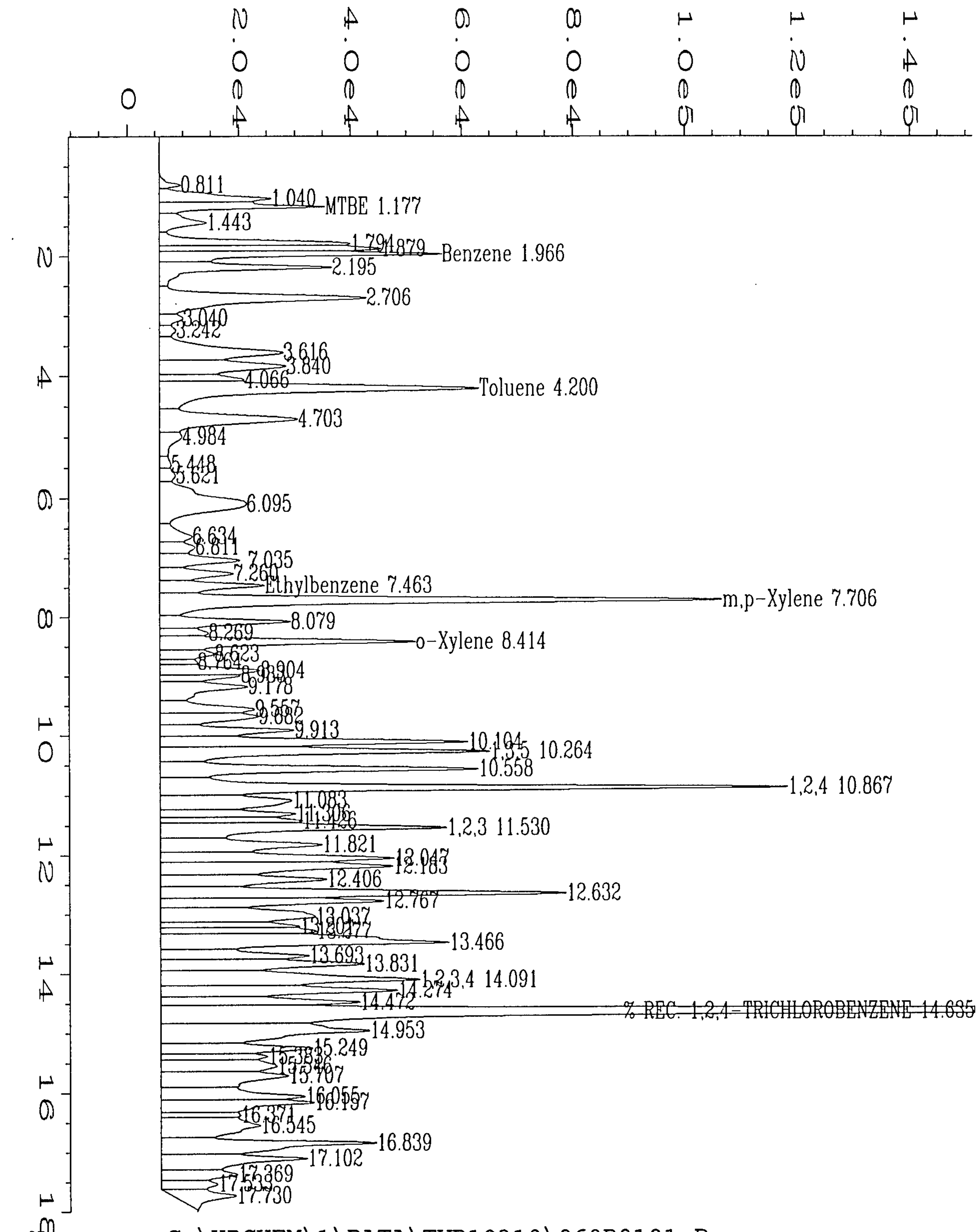
Comments: * = of Fuel Weathering Study

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

[signature] **Analyst**

[signature] **Approved**



Data File Name : C:\HPCHEM\1\DATA\TVB10310\060R0101.D
Operator : H. Diane Mills
Instrument : TVHBTEX1
Sample Name : 97-0751-02A-FU
Run Time Bar Code:
Acquired on : 12 Mar 97 03:43 PM
Report Created on: 12 Mar 97 04:01 PM
Last Recalib on : 11 MAR 97 10:15 AM
Multiplier : 2.5e+005
Sample Info : SAMP BTEX_O
::SHMW1610-2; 2.0 UL OF 1/100 OF EXT. OF FUEL PORTION

Page Number : 1
Vial Number : 60
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10310.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	SHMW1610-2	Client Project No.	:	FUEL WEATHERING STUDY
Lab Sample Number	:	97-0751-02	Lab Work Order	:	97-0751
Date Sampled	:	3/6/97	Matrix	:	AQEUOUS PORTION*
Date Received	:	3/7/97	Lab File Number(s)	:	TVB10313008
Date Prepared	:	3/11/97	Method Blank	:	FMB031197
FID Dilution Factor	:	200			
PID Dilution Factor	:	200			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/13/97	10,000	80	ug/L
Toluene	108-88-3	3/13/97	5910	80	ug/L
Ethyl Benzene	100-41-4	3/13/97	329	80	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/13/97	1900	80	ug/L
o-Xylene	95-47-6	3/13/97	1130	80	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		111%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = of Fuel Weathering Study

QUALIFIERS and DEFINITIONS:

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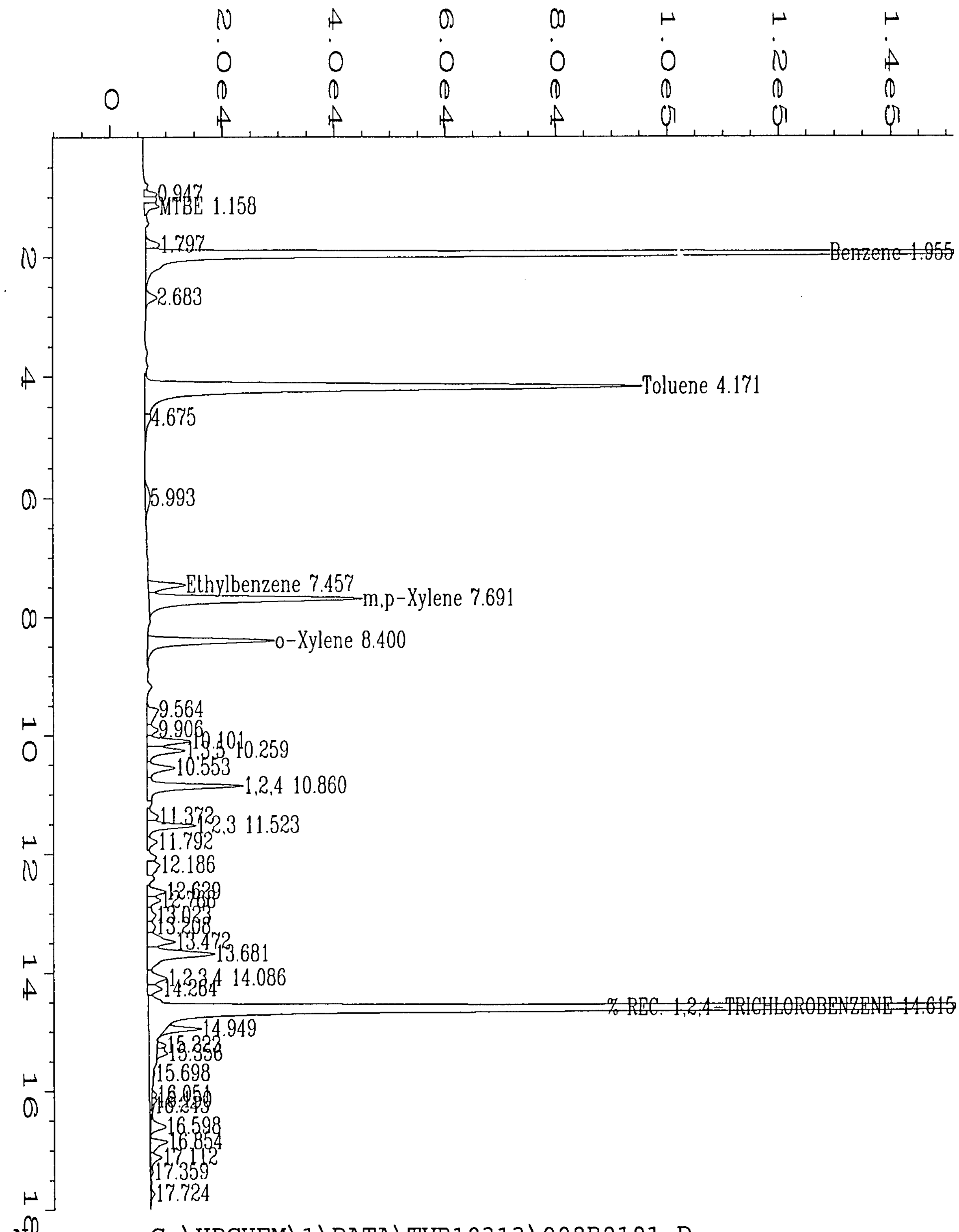
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10313\008R0101.D
Operator : H. Diane Mills
Instrument : TVHBTEX1
Sample Name : 97-0751-02A-AQ
Run Time Bar Code:
Acquired on : 13 Mar 97 01:19 PM
Report Created on: 13 Mar 97 01:37 PM
Last Recalib on : 11 MAR 97 10:15 AM
Multiplier : 200
Sample Info : SAMP BTEX_O
::SHMW1610-2; 25 UL AQUEOUS PART OF EXTRACT

Page Number : 1
Vial Number : 8
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10310.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	SHMW1610-2	Client Project No.	:	FUEL WEATHERING STUDY
Lab Sample Number	:	97-0751-02-DUP	Lab Work Order	:	97-0751
Date Sampled	:	3/6/97	Matrix	:	FUEL PORTION*
Date Received	:	3/7/97	Lab File Number(s)	:	TVB10310073
Date Prepared	:	3/11/97	Method Blank	:	FMB031197
FID Dilution Factor	:	250,000			
PID Dilution Factor	:	250,000			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/12/97	2,290,000	1,000,000	ug/L
Toluene	108-88-3	3/12/97	5,080,000	1,000,000	ug/L
Ethyl Benzene	100-41-4	3/12/97	1,510,000	1,000,000	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/12/97	6,370,000	1,000,000	ug/L
o-Xylene	95-47-6	3/12/97	2,890,000	1,000,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		116%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = of Fuel Weathering Study

QUALIFIERS and DEFINITIONS:

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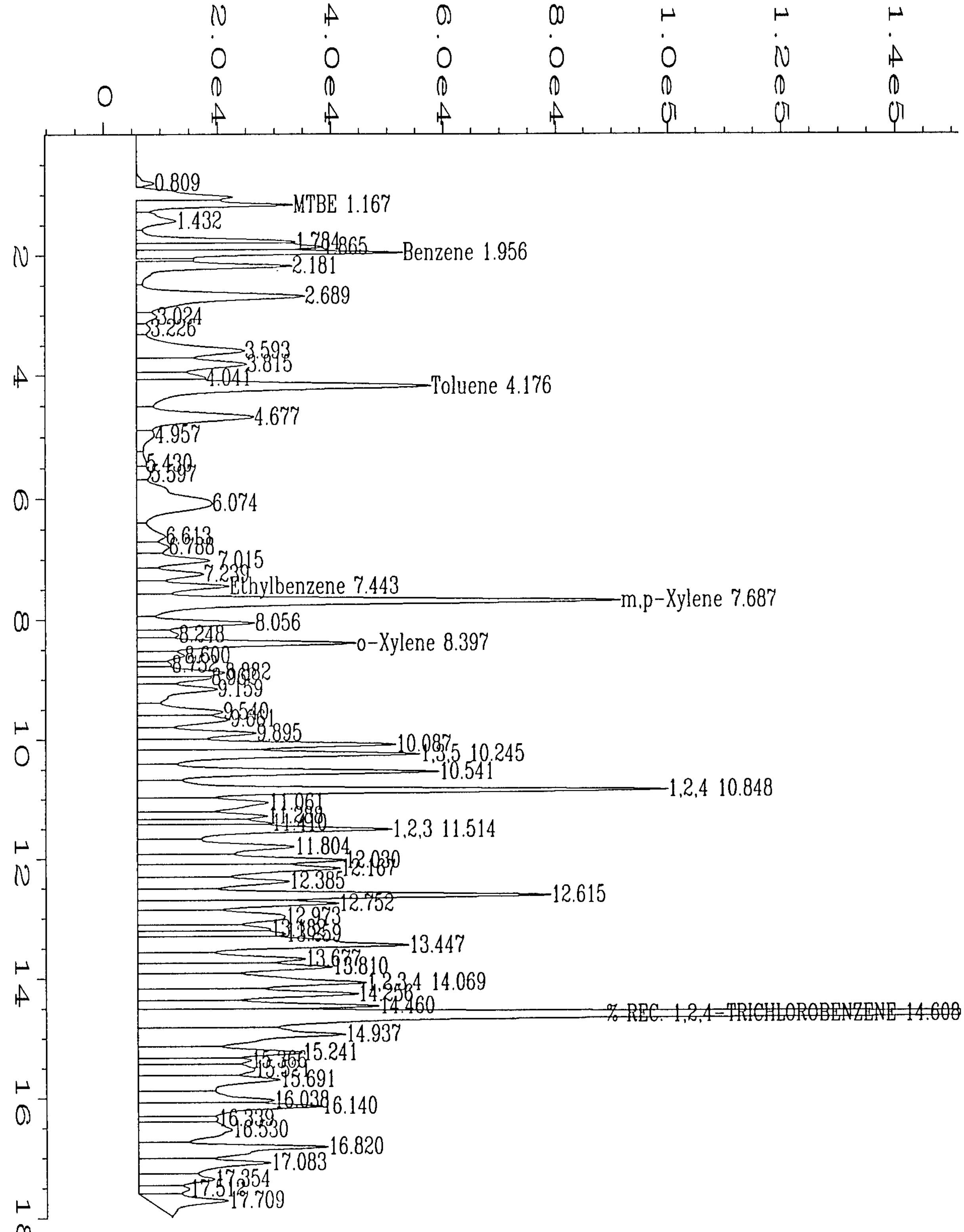
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

DH
Analyst

A McClella
Approved

TVBXWS1;TVBF0751.XLS; 3/17/97; 7



Data File Name	: C:\HPCHEM\1\DATA\TVB10310\073R0101.D			
Operator	: H. Diane Mills	Page Number	:	1
Instrument	: TVHBTEX1	Vial Number	:	73
Sample Name	: 97-0751-02ADUPFU	Injection Number	:	1
Run Time Bar Code:		Sequence Line	:	1
Acquired on	: 12 Mar 97 11:03 PM	Instrument Method:		TVH11216.MTH
Report Created on:	13 Mar 97 08:41 AM	Analysis Method	:	BX10310.MTH
Last Recalib on	: 11 MAR 97 10:15 AM	Sample Amount	:	0
Multiplier	: 2.5e+005	ISTD Amount	:	
Sample Info	: DUP BTEX_O			
	::SHMW1610-2; 2.0 UL OF 1/100 OF EXT. OF FUEL PORTION			

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	SHMW1610-2	Client Project No.	:	FUEL WEATHERING STUDY
Lab Sample Number	:	97-0751-02-DUP	Lab Work Order	:	97-0751
Date Sampled	:	3/6/97	Matrix	:	AQEUOUS PORTION*
Date Received	:	3/7/97	Lab File Number(s)	:	TVB10310075
Date Prepared	:	3/11/97	Method Blank	:	FMB031197
FID Dilution Factor	:	100			
PID Dilution Factor	:	100			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/13/97	6840	40	ug/L
Toluene	108-88-3	3/13/97	6070	40	ug/L
Ethyl Benzene	100-41-4	3/13/97	436	40	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/13/97	2180	40	ug/L
o-Xylene	95-47-6	3/13/97	1230	40	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		101%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = of Fuel Weathering Study

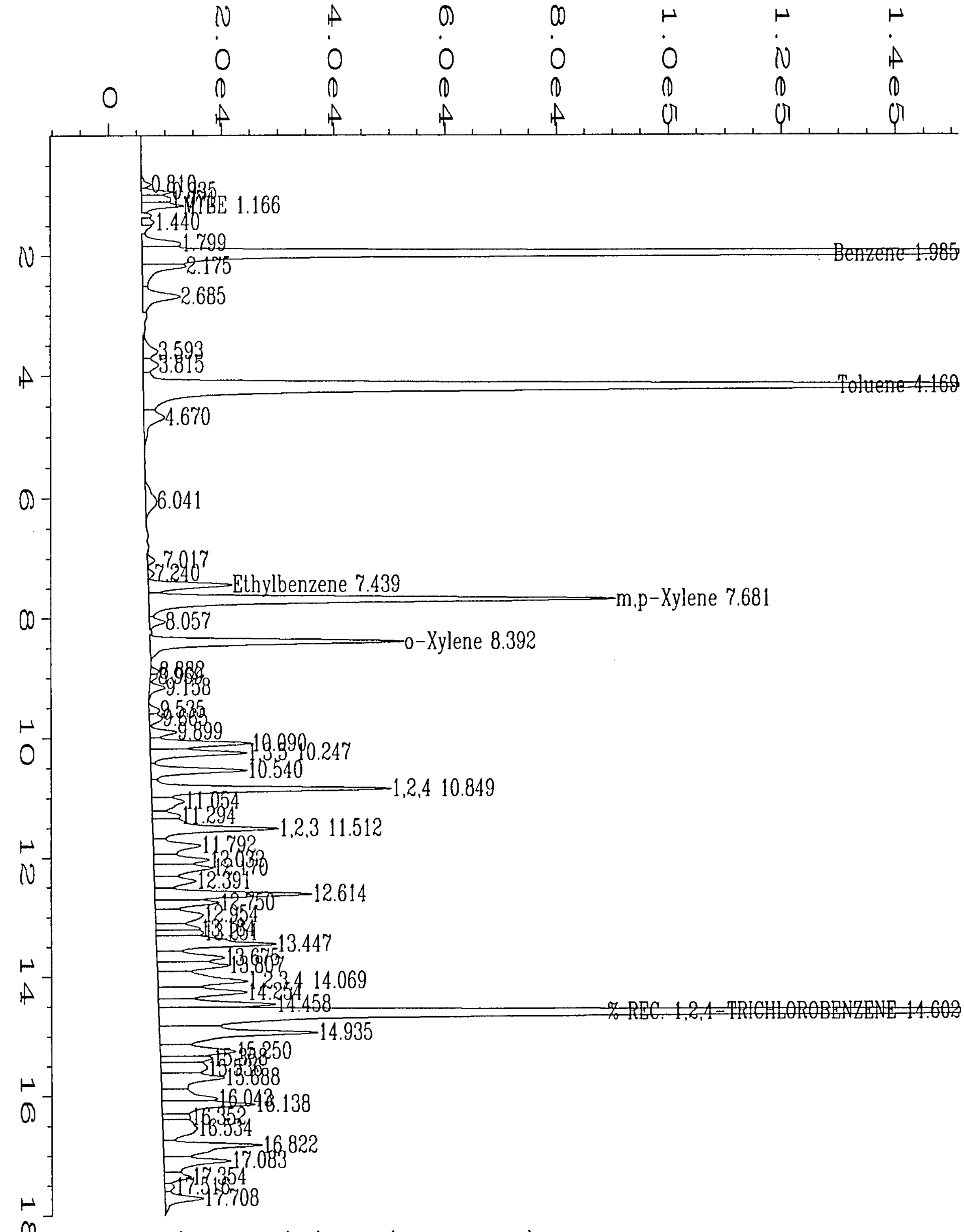
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved

TVBXWS1;TVBF0751.XLS; 3/17/97; 6



Data File Name	: C:\HPCHEM\1\DATA\TVB10310\075R0101.D			
Operator	: H. Diane Mills	Page Number	:	1
Instrument	: TVHBTEX1	Vial Number	:	75
Sample Name	: 97-0751-02ADUPAQ	Injection Number	:	1
Run Time Bar Code	:	Sequence Line	:	1
Acquired on	: 13 Mar 97 00:10 AM	Instrument Method	:	TVH11216.MTH
Report Created on	: 13 Mar 97 08:43 AM	Analysis Method	:	BX10310.MTH
Last Recalib on	: 11 MAR 97 10:15 AM	Sample Amount	:	0
Multiplier	: 100	ISTD Amount	:	
Sample Info	: DUP BTEX_O			
	::SHMW1610-2; 50 UL AQUEOUS PART OF EXTRACT			

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	: FMB031197	Client Project No.	: FUEL WEATHERING STUDY
Date Prepared	: 3/11/97	Lab Work Order	: 97-0751
Dilution Factor	: 1.0	Matrix	: WATER
		Lab File Number	: TVB10310048

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	3/11/97	U	0.4	ug/L
Toluene	108-88-3	3/11/97	U	0.4	ug/L
Ethyl Benzene	100-41-4	3/11/97	U	0.4	ug/L
m,p-Xylenes	108-38-3;106-42-3	3/11/97	U	0.4	ug/L
o-Xylene	95-47-6	3/11/97	U	0.4	ug/L
FID Surrogate Recovery:	NA			78%-127%	(Limits)
PID Surrogate Recovery:		93%		76%-120%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

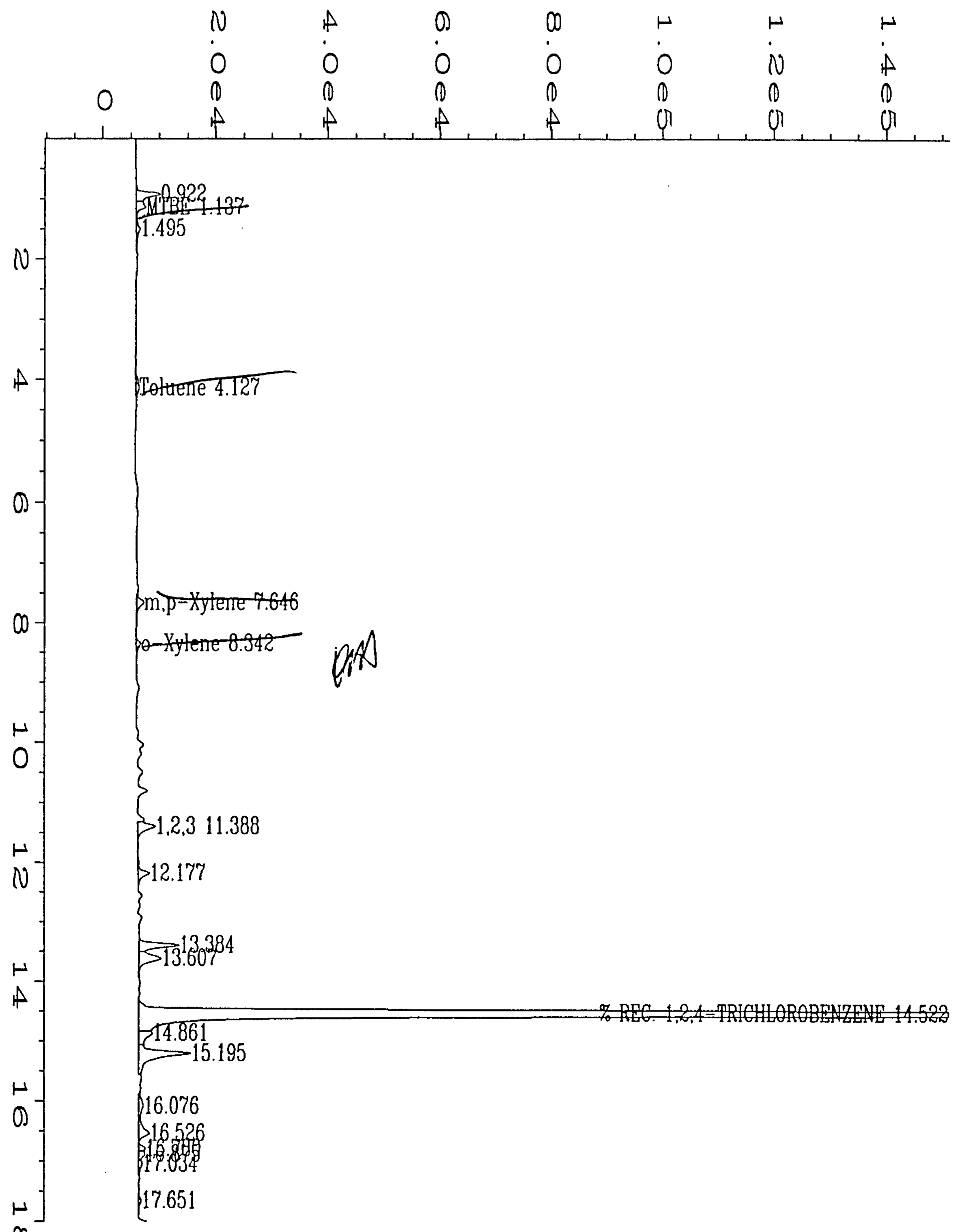
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

[signature]
Analyst

[signature] A McClellan
Approved

TVBXWS1;TVBF0751.XLS; 3/17/97; 1



Data File Name : C:\HPCHEM\1\DATA\TVB10310\048R0101.D
Operator : H. Diane Mills
Instrument : TVHBTEX1
Sample Name : FMB031197
Run Time Bar Code:
Acquired on : 11 Mar 97 08:58 PM
Report Created on: 11 Mar 97 09:17 PM
Last Recalib on : 11 MAR 97 10:15 AM
Multiplier : 1
Sample Info : FUEL EXTRACTION METHOD BLANK

Page Number : 1
Vial Number : 48
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10310.MTH
Sample Amount : 0
ISTD Amount :

* Dionized distilled

Fuel Weathering Study

3/11/97 FMB031197 40.ml H_2O* in 40ml VOA — DAS

+

97-0751-01A1 + 2.0ml fuel DAS

-02A1 DAS DAS

97-0751-02A1-Dup

Start shaking @ 2:43pm with Wrist shaker

off @ 3:13pm

upsidedown @ 3:16pm

phases separated after 1 hr. DAS 3/11/97

Aq = Aqueous

Fu = fuel

LAB PROJECT #: 97- 0751 SAMPLE PROJECT CHECKLIST REVIEWED BY: ______

EPA ANALYSIS (CIRCLE): 602/8020, MTBE, TMBs, 8015M-TVH, OTHER (SPECIFY): Fuel Weathering Study

Notes: *RR*=re-run; *LS*=low surrogate recovery; *D*F=dilution factor; *NP*=no purge.

LAB SAMPLE #	HOLDING TIME	MATRIX S,W,A	#1 SAMPLE DATE LOADED	DF	ANALYSIS	COMMENTS 1ST ANALYSIS (ANALYSIS OK?)	#2 SAMPLE DATE LOADED	ANALYSIS	COMMENTS 2ND ANALYSIS (ANALYSIS OK?)	#3 SAMPLE DATE LOADED	ANALYSIS	OTHER COMMENTS
1Ag		A	3/11	5000	3/11	RR@10	3/12	3/12	RR@25 (0.2ml)	3/12	3/12	ok
2Ag		↓	3/12	25	3/12	RR@100	3/12	3/12	OS, RR@ ~~25~~ DF=200 25	3/13	3/13	
2Dup Ag		V	3/12	25	3/12	V	3/12	3/13	ok			
1A fuel ext		O	3/12	50000	3/12	RR@250,000	3/12	3/12	ok			
2A fuel ext		↓	3/12	250,000	3/12	ok						
2A Dup fuel ext		V	3/12	250,000	3/12	ok						
EMB	(Blank)	W	3/11	1	3/11	OK						
-MS												
-MSD												
-MS												
-MSD												

QC FOR EACH MATRIX SUCCESSFULLLY ANALYZED? ______

SPCKLST1.XLS

Evergreen
Analytical
Laboratory

May 30, 1997

- Seymour Johnson
SJ
CH - DFSP - Charleston
(Hanahan)
Fresh JP-5
Coal Field

MR CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY STE 900
DENVER, CO 80290

Work Order: 97-1841
Client Project: Fuel Weathering Study

Dear Mr. Synder:

Enclosed are the analytical results for the samples shown in the Work Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Carl Smits, Vice President of Quality Assurance.

SAMPLE DISPOSAL: Except for high level PCB, mercury, and dioxin samples, EAL will dispose of all samples one month from the date of this letter. If you want samples returned, please advise us by mail or fax as soon as possible.

RECORDS RETENTION: Effective January 1, 1996 we will retain a copy of this project report and supporting data for a period of three years. It has been our experience that a three year retention period is more than adequate to respond to client inquiries. If you want the project file sent to you after the three year period, please return a copy of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Jack Barney /cm

Jack Barney
President

Evergreen Analytical, Inc.

97-1841

WORK ORDER Summary

21-May-97

Report To: Craig Snyder
Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Client Project ID: Fuel Weathering Study

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments: Analyze IAW organic and aqueous phases

QC Level: Laboratory Standard QC

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
97-1841-01A	SJMW1SFP	BTEX		Organic	2	15-May-97	21-May-97	05-Jun-97	29-May-97
97-1841-02A	SJMW2SFP	BTEX						05-Jun-97	29-May-97
97-1841-03A	CH-W103	BTEX				16-May-97		05-Jun-97	30-May-97
97-1841-04A	CH-EW6	BTEX				17-May-97		05-Jun-97	31-May-97
97-1841-05A	Fresh JP-5 Sample	BTEX				19-May-97		05-Jun-97	02-Jun-97
97-1841-06A	CEF-293-9	BTEX				20-May-97		05-Jun-97	03-Jun-97

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

MM 5/21

[redacted] CHA[redacted]IN O[redacted]USTODY[redacted]ECOR[redacted] / A[redacted]ALYT[redacted]AL[redacted]RVI[redacted]S [redacted]QUE[redacted]

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
CLIENT PROJ. I.D. Fuel Weathering Study
EAL. QUOTE # ____ P.O.# 729691.3573[illegible]
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ UST ☐ Other (Specify)*
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder

Please **PRINT** all information:

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: ~~Oil / Sludge / Multi-phase~~ Free product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	For Laboratory use only
SJMW1SFP	5/15/97	0900	1			X								X							-01 A
SJMW2SFP	5/15/97	0900	1			X								X							-02
CH-W103	5/16/97	1600	1			X								X							-03
CH-EW6	5/17/97	1130	1			X								X							-04
Fresh JP-5 Sample	5/19/97	0930	1			X								X							-05
CEF-293-9	5/20/97	1120	1			X								X							-06

Sample Fraction
Container

For Laboratory use only
W.O. # 97-1841
B.O.F. # 489
C/S (O) 10 / UPS[illegible]
C/S (I) 10 / Co
Cooler Temp. °C 6
Seals Intact Y / N / NA
Samples Pres. Y / N / NA
Headspace Y / N / NA
By 7C1
Loc 2

Instructions:
SJ = Seymour Johnson - JP-8 fuel product; CH = DFSP-Charleston JP-4 fuel free product
** ANALYZE IAW Feb 28, 1997 Ltr fr/ Parsons to Patty McClellan Organic & Aqueous Pha[illegible]

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	5/20/97 1800	Courier		Courier		J DeChas	5/21/97 9:30

PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

February 28, 1997

Ms. Patty McClellan
Evergreen Analytical, Inc.
4036 Youngfield
Wheat Ridge, CO 80033

Subject: Fuel/Water Partitioning Analyses for AFCEE Fuel Weathering Study

Dear Ms. McClellan:

The purpose of this letter is to explain the analyses requested from Evergreen Analytical Inc. (Evergreen) to support the Air Force Center for Environmental Excellence (AFCEE) Fuel Weathering study being performed by Parsons Engineering Science, Inc. (Parsons ES). The primary objective of the study is to determine an average range of natural weathering (degradation) rates for fuels released to the subsurface environment. A secondary objective is to determine fuel/water partition coefficients (K_{fw}) at equilibrium saturations. We are hopeful that Evergreen can support us in evaluating fuel/water partitioning.

Determination of K_{fw}'s for gasoline/water mixtures was performed by Cline et al (1991) (see attached). For their study, saturated, equilibrium solutions of gasolines in contact with distilled, deionized, organic-free water were prepared. Two milliliters (mL) of fuel were added to 40 mL of water in VOA vials having Teflon-septa (a 1:20 fuel to water ratio). Samples were mixed on a rotating disk apparatus for 30 minutes at $22 \pm 1°C$. The vials were then allowed to sit undisturbed for 1 hour in an inverted position. From each VOA bottle, the separated water phase was removed through the septum at the bottom of the VOA bottle using a 5-mL syringe. The extracted water phase was then stored in 2-mL crimp seal vials and refrigerated until gas chromatography with flame ionization detection (GC/FID) could be performed.

We wish to follow the same basic procedures as the Cline et al study; however, we would like for both the aqueous phase and the organic (fuel) phase to be analyzed individually following the 30 minute rotation and 1 hour inverted stabilization. We request that each phase be analyzed for determination of benzene, toluene, ethylbenzene, and total xylenes (BTEX) concentrations by USEPA SW8020 by gas chromatography with photoionization detection (GC/PID). Concentrations should be reported in milligrams per liter (mg/L). Our fuel weathering study will look at a variety of fuels (JP-4, JP-5, JP-8 jet fuels and gasoline) collected from ten separate sites. We anticipate submitting to Evergreen either one or two fuel samples per site with one duplicate being submitted for every five sites sampled. We understand that the cost for analysis will be $60.00 for the aqueous phase and $85.00 for the organic phase. Depending upon whether one or two samples are submitted per site, we anticipate that between 12 and 22 fuel samples total will be sent to Evergreen for analysis as part of the study.

We also are submitting fuel samples to the USEPA National Risk Management Research Laboratory (NRMRL) in Ada, Oklahoma and to the Arthur D. Little Laboratory in Cambridge, Massachusetts for other fuel analyses. If possible, we would like to obtain from Evergreen approximately 36 20-mL VOA bottles to support sample collection and submission to the various labs.

At present, seven sites have been selected for the study. During the week of March 3, 1997, we will be collecting samples from the first two sites and anticipate sending to Evergreen two to five fuel samples for analysis as described above. Sampling of the other five sites is likely to occur during one or two separate mobilizations during the Spring/early Summer of 1997. Hopefully, we will be able to identify three other sites to include in the study and sample later this year.

The analytical procedures we have described above are subject to change following review of this letter and the attachment by Evergreen and by Mr. Doug Downey, our Technical Director for the study. Next week, we will have to confirm with you the exact procedures to be followed before analyzing the first round of samples. If you have any questions or comments, please feel free to contact me at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Craig B. Snyder

Craig B. Snyder
Task Manager

Enclosures

cc: D. Downey
D. Moutoux
M. Vessely
File

#mL
olvent

Fuel Weathering study

		amount water *	amount Fuel (2.0ml)	Container
5/22/97	FMB052297	40ml	2.0ml	40ml VOA
	97-1841-01			
	-02			
	-03			
	-04			
	-05			
	-06			
	-06 Dup			

* ~~Dau~~ Double distilled H_2O

Start Shake @ 12:23pm

end " @ 1:58pm

DAA

let stand 1.0 HR to equilibrate

DAA 5/22/97

separate fuel + aqueous portions + vial up. (fuel in 2.0ml vials + aq. in 12ml vials). DAA

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: SJMW1SFP	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-01	Lab Work Order	: 97-1841
Date Sampled	: 5/15/97	Matrix	: Aqueous Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522020
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 25		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/22/97	720	10	ug/L
Toluene	108-88-3	5/22/97	990	10	ug/L
Ethyl Benzene	100-41-4	5/22/97	290	10	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/22/97	1800	10	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		109%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

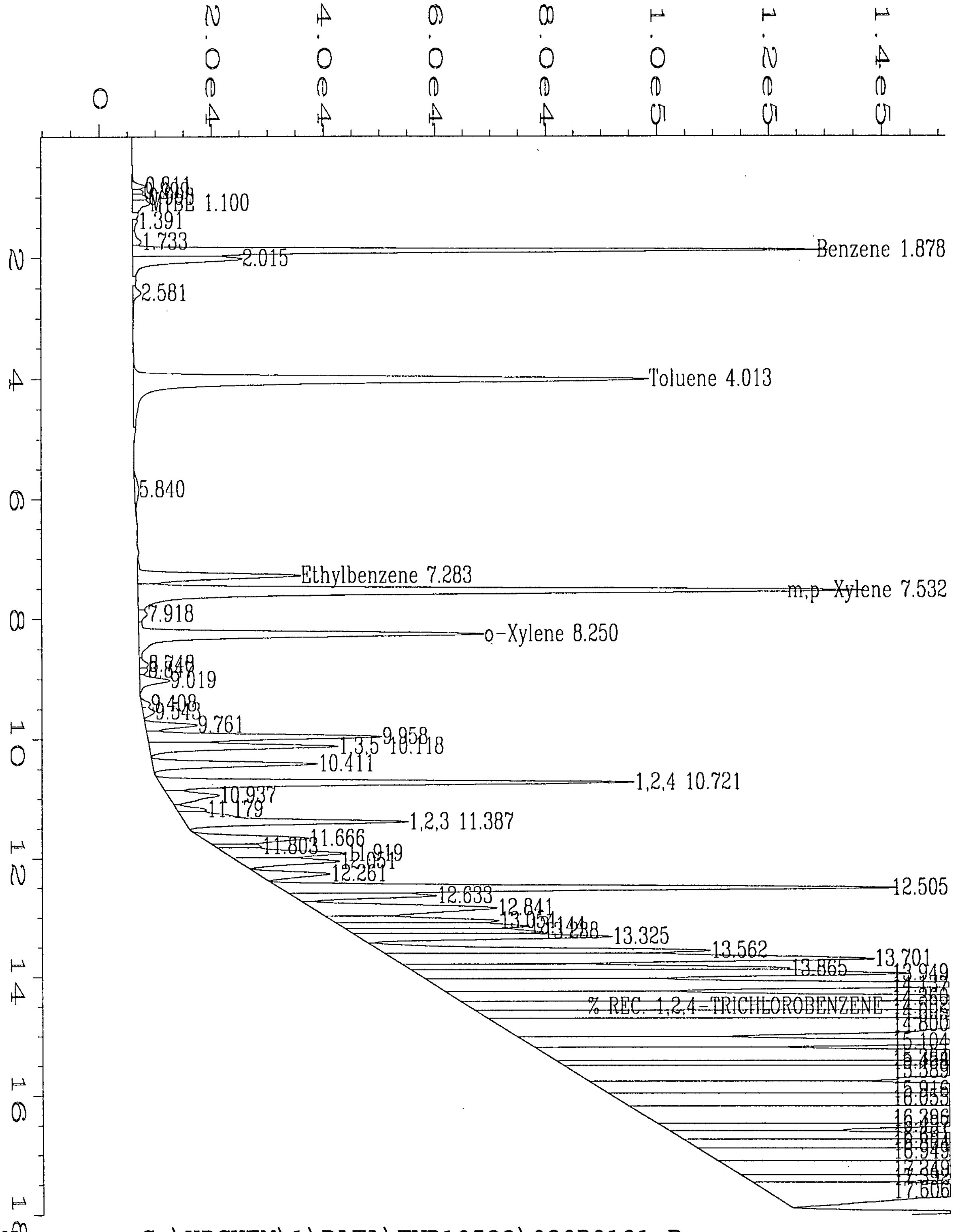
Comments: * of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

[signature] **Analyst**

[signature] **Approved**



Data File Name	: C:\HPCHEM\1\DATA\TVB10522\020R0101.D		
Operator	: H. D. Mills	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 20
Sample Name	: 97-1841-01A1-AQ	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 1
Acquired on	: 22 May 97 07:58 PM	Instrument Method:	TVH11216.MTH
Report Created on:	22 May 97 08:17 PM	Analysis Method	: BX10331.MTH
Last Recalib on	: 01 APR 97 11:26 AM	Sample Amount	: 0
Multiplier	: 25	ISTD Amount	:
Sample Info	: SAMP BTEX_W		

::SJMW1SFP; 0.200 ML AQUEOUS PORTION: FUEL WEATHERING STUDY

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: SJMW2SFP	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-02	Lab Work Order	: 97-1841
Date Sampled	: 5/15/97	Matrix	: Aqueous Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522028
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 25		

Compound Name	as Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	810	10	ug/L
Toluene	108-88-3	5/23/97	1100	10	ug/L
Ethyl Benzene	100-41-4	5/23/97	340	10	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/23/97	2100	10	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		123%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * of Fuel Weathering Study.

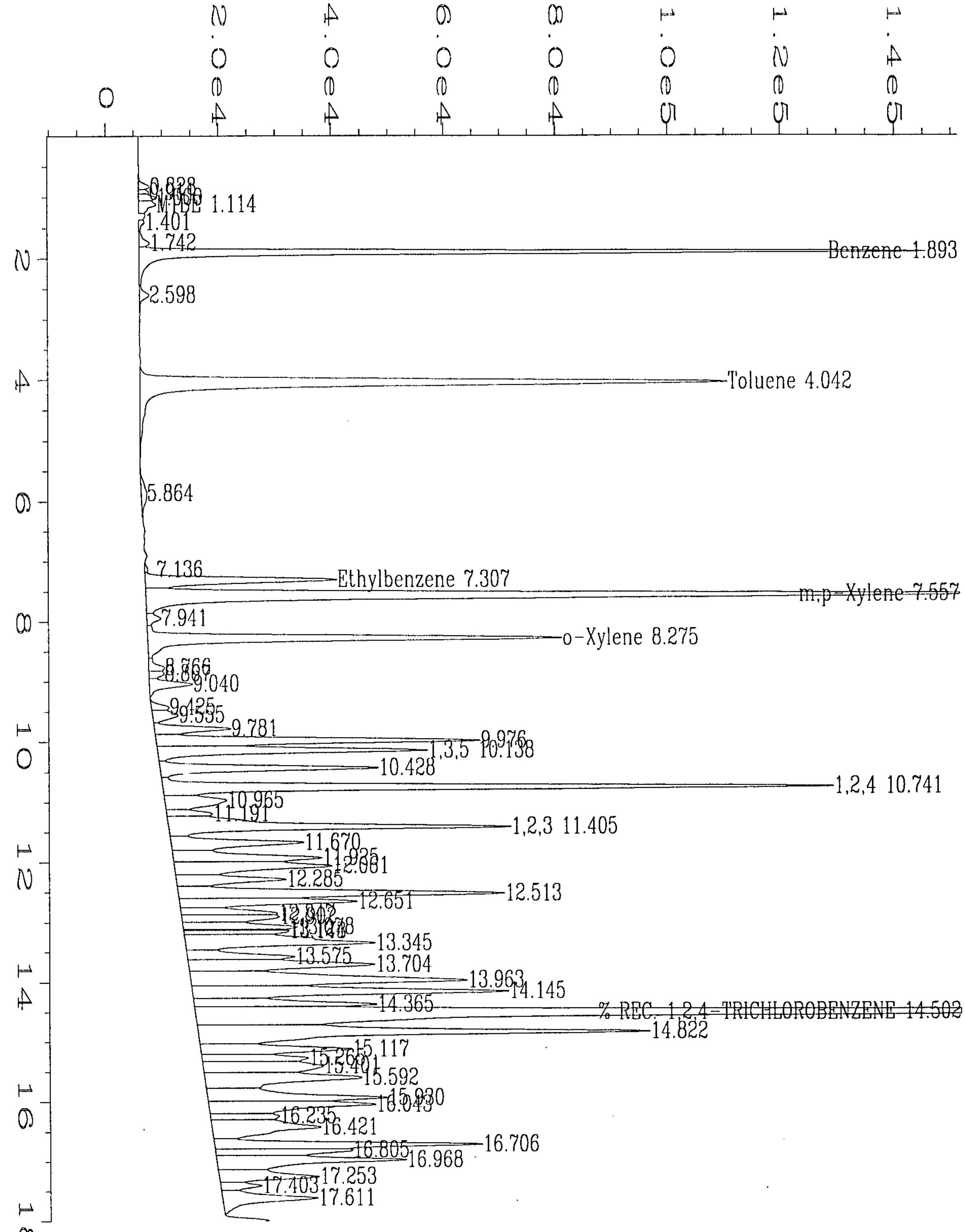
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

HDMills
Analyst

Approved

TVBXWS1;TV1841AQ.XLS; 5/29/97; 3



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Operator	: H. D. Mills	Page Number	: 1		
Instrument	: TVHBTEX1	Vial Number	: 28		
Sample Name	: 97-1841-02A1-AQ	Injection Number	: 1		
Run Time Bar Code:		Sequence Line	: 1		
Acquired on	: 23 May 97 00:25 AM	Instrument Method:	TVH11216.MTH		
Report Created on:	23 May 97 00:44 AM	Analysis Method	: BX10331.MTH		
Last Recalib on	: 01 APR 97 11:26 AM	Sample Amount	: 0		
Multiplier	: 25	ISTD Amount	:		
Sample Info	: SAMP BTEX_W				

::SJMW2SFP; 0.200 ML AQUEOUS PORTION: FUEL WEATHERING STUDY

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CH-W103	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-03	Lab Work Order	: 97-1841
Date Sampled	: 5/16/97	Matrix	: Aqueous Pc tion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522029
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 25		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	U	10	ug/L
Toluene	108-88-3	5/23/97	200	10	ug/L
Ethyl Benzene	100-41-4	5/23/97	260	10	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/23/97	1500	10	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		112%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

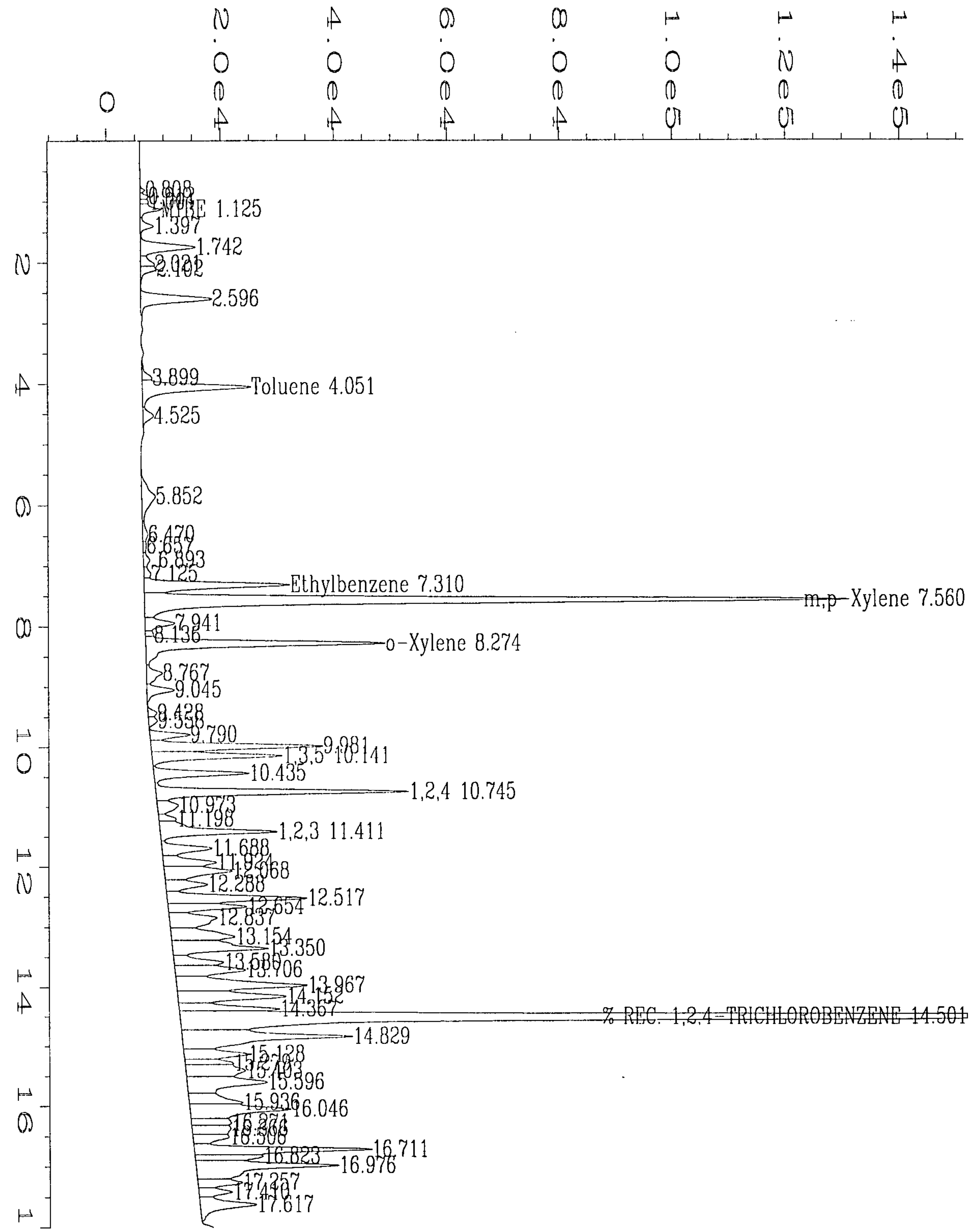
Comments: * of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

HDMills
Analyst

Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10522\029R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : 97-1841-03A1-AQ
Run Time Bar Code:
Acquired on : 23 May 97 00:59 AM
Report Created on: 23 May 97 01:17 AM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 25
Sample Info : SAMP BTEX_W
::CH-W103; 0.200 ML AQUEOUS PORTION: FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 29
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CH-EW6	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-04	Lab Work Order	: 97-1841
Date Sampled	: 5/17/97	Matrix	: Aqueous Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522049
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 5.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	2.3	2.0	ug/L
Toluene	108-88-3	5/23/97	U	2.0	ug/L
Ethyl Benzene	100-41-4	5/23/97	19	2.0	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/23/97	85	2.0	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		125%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

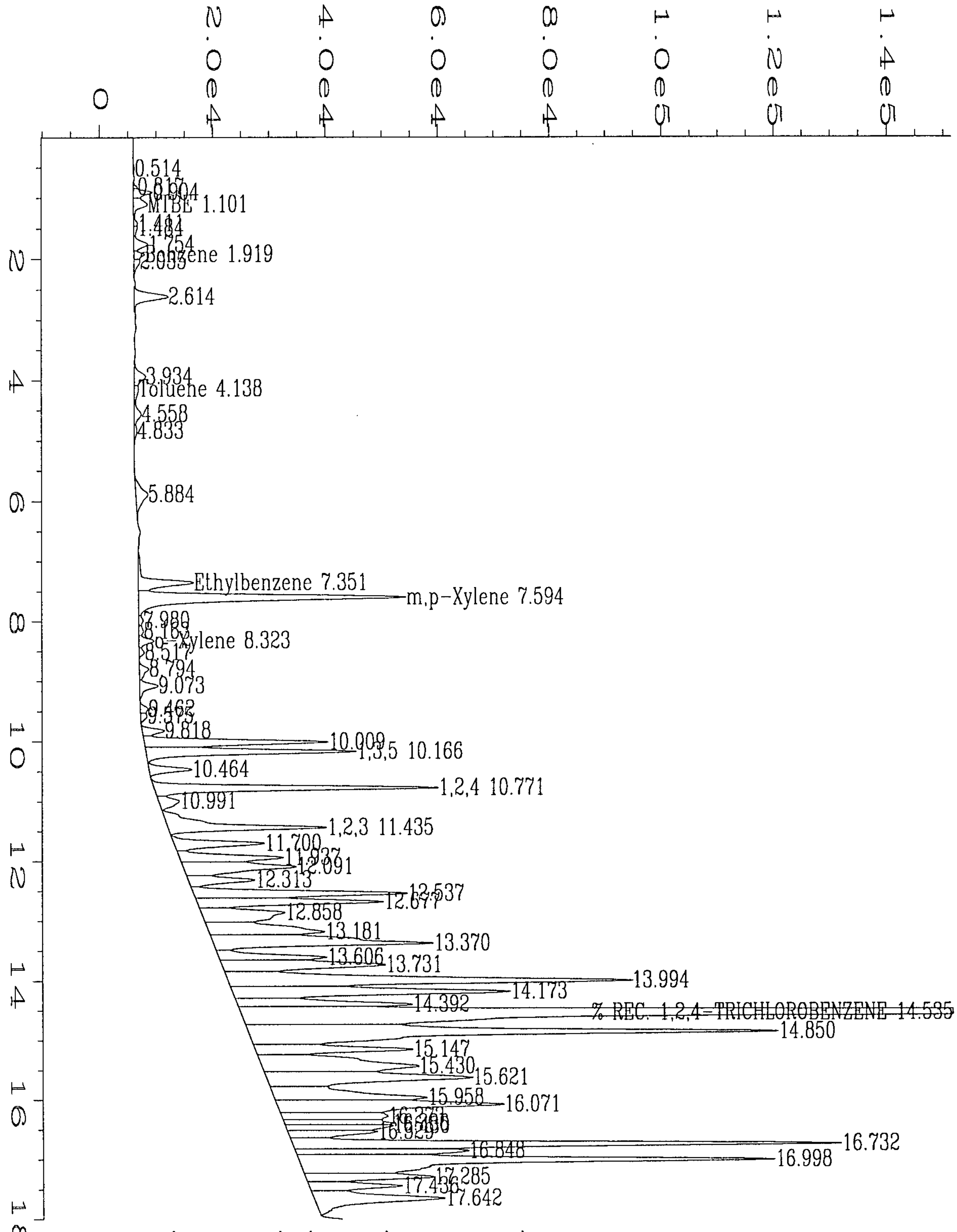
Comments: * of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

HDMills
Analyst

VHA
Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10522\049R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : 97-1841-04A1-AQ
Run Time Bar Code:
Acquired on : 23 May 97 06:02 PM
Report Created on: 23 May 97 06:21 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 5
Sample Info : SAMP BTEX_W
::CH-EW6; 1.0 ML AQUEOUS PORTION: FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 49
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	Fresh JP-5 Sample	Client Project	:	Fuel Weathering Study
Lab Sample Number	:	97-1841-05	Lab Work Order	:	97-1841
Date Sampled	:	5/19/97	Matrix	:	Aqueous Portion*
Date Received	:	5/21/97	Lab File Number(s)	:	TVB10522050
Date Prepared	:	5/22/97	Method Blank	:	FMB052297
FID Dilution Factor	:	NA			
PID Dilution Factor	:	5.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	3.3	2.0	ug/L
Toluene	108-88-3	5/23/97	24	2.0	ug/L
Ethyl Benzene	100-41-4	5/23/97	81	2.0	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/23/97	540	2.0	ug/L
FID Surrogate Recovery:		NA		50%-150%	(Limits)
PID Surrogate Recovery:		115%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * of Fuel Weathering Study.

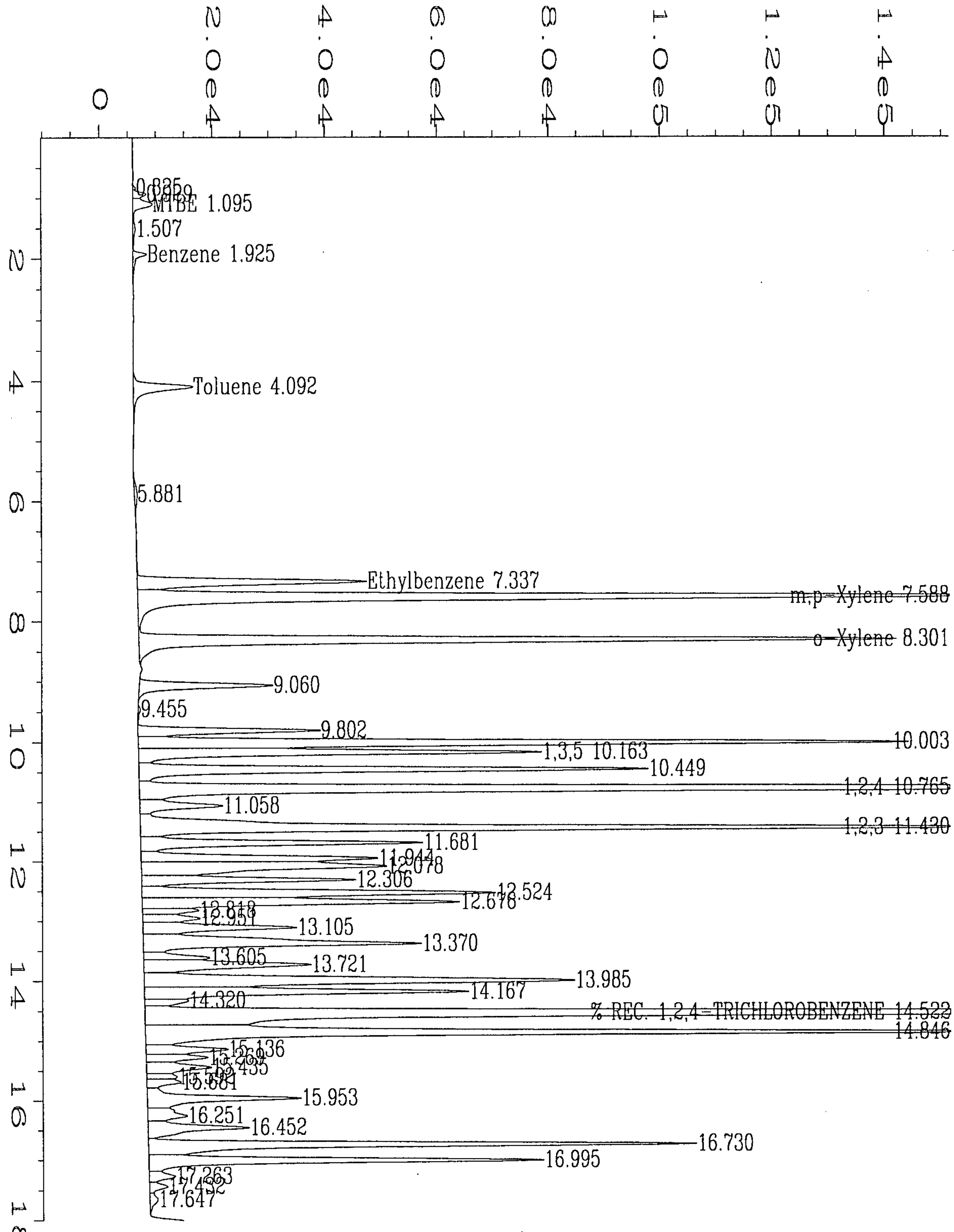
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

HDMills
Analyst

DAH
Approved

TVBXWS1;TV1841AQ.XLS; 5/29/97; 6



Data File Name : C:\HPCHEM\1\DATA\TVB10522\050R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : 97-1841-05A1-AQ
Run Time Bar Code:
Acquired on : 23 May 97 06:36 PM
Report Created on: 23 May 97 06:54 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 5
Sample Info : SAMP BTEX_W
::Fresh JP-5 Sample; 1.0 ML AQUEOUS PORTION: FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 50
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CEF-293-9	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-06	Lab Work Order	: 97-1841
Date Sampled	: 5/20/97	Matrix	: Aqueous Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522031
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 25		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	93	10	ug/L
Toluene	108-88-3	5/23/97	83	10	ug/L
Ethyl Benzene	100-41-4	5/23/97	550	10	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/23/97	1100	10	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		104%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

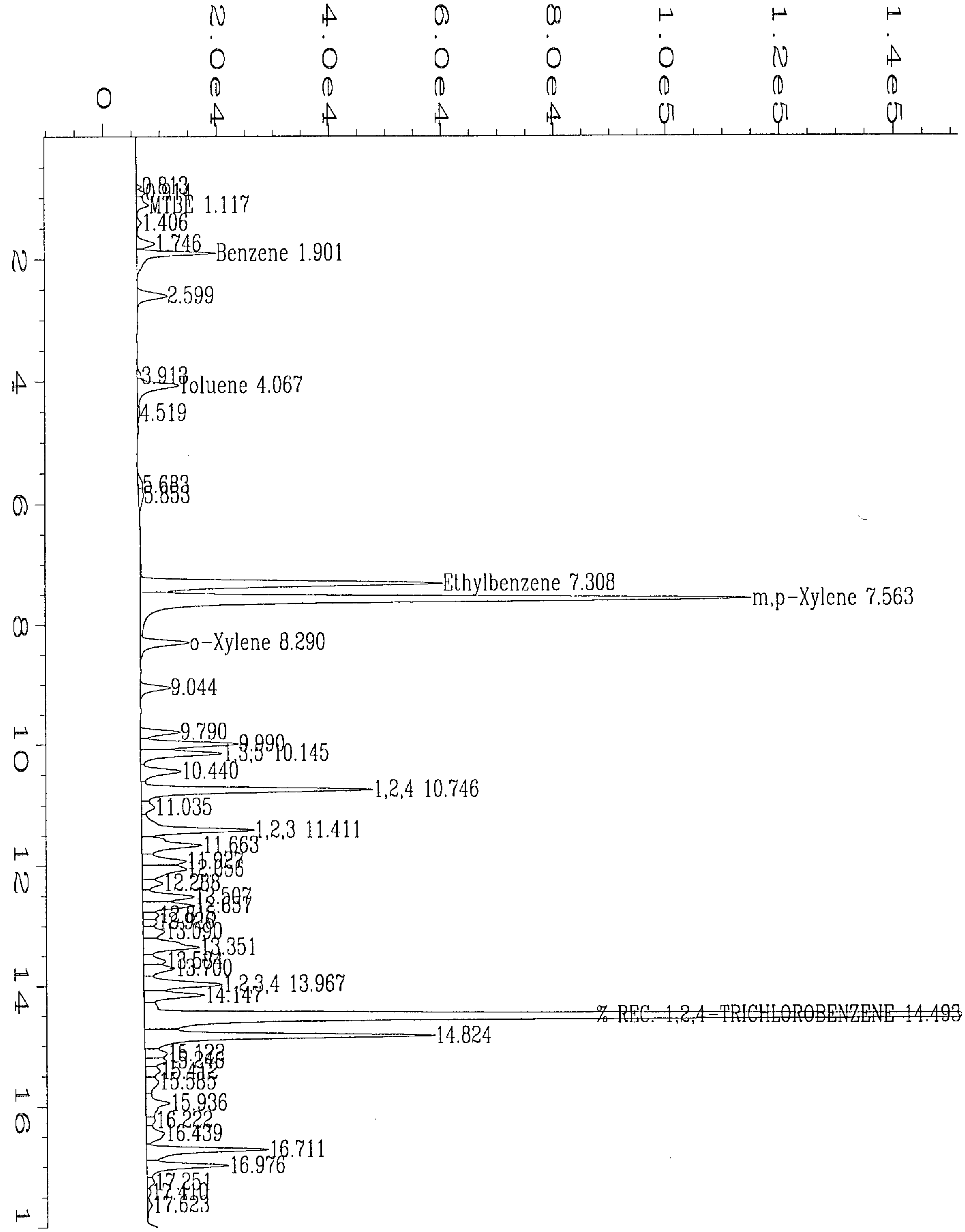
Comments: * of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

[signature]
Analyst

[signature]
Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10522\031R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : 97-1841-06A1-AQ
Run Time Bar Code:
Acquired on : 23 May 97 02:05 AM
Report Created on: 23 May 97 02:24 AM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 25
Sample Info : SAMP BTEX_W
: : CEF-293-9; 0.200 ML AQUEOUS PORTION: FUEL
WEATHERING STUDY

Page Number : 1
Vial Number : 31
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: SJMW1SFP	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-01	Lab Work Order	: 97-1841
Date Sampled	: 5/15/97	Matrix	: Fuel Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522025
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 250,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/22/97	150,000 J	1,000,000	ug/L
Toluene	108-88-3	5/22/97	1,000,000	1,000,000	ug/L
Ethyl Benzene	100-41-4	5/22/97	790,000 J	1,000,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/22/97	5,200,000	1,000,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		112%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

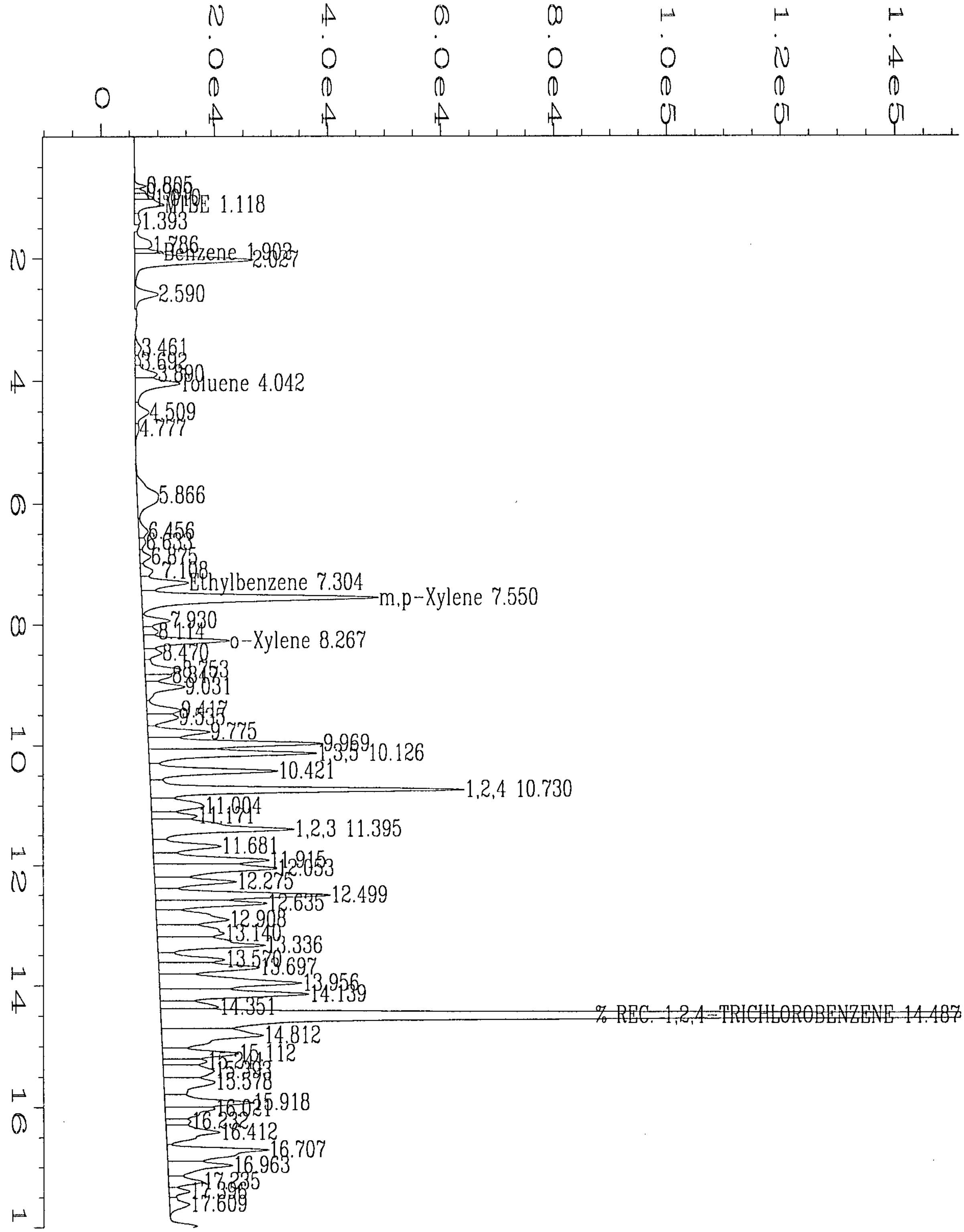
Comments: * of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H.D. Mills
Analyst

[signature]
Approved

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Instrument       : TVHBTEX1                       Vial Number       : 25
Sample Name      : 97-1841-01A1-F                 Injection Number  : 1
un Time Bar Code:                                 Sequence Line     : 1
cquired on       : 22 May 97  10:45 PM            Instrument Method: TVH11216.MTH
Report Created on: 22 May 97  11:04 PM            Analysis Method   : BX10331.MTH
ast Recalib on   : 01 APR 97 11:26 AM             Sample Amount     : 0
ultiplier        : 2.5e+005                       ISTD Amount       :
Sample Info      : SAMP BTEX_W
                   ::SJMW1SFP; 2 ul of 1/100 Fuel extract
```

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	SJMW2SFP	Client Project	:	Fuel Weathering Study
Lab Sample Number	:	97-1841-02	Lab Work Order	:	97-1841
Date Sampled	:	5/15/97	Matrix	:	Fuel Portion*
Date Received	:	5/21/97	Lab File Number(s)	:	TVB10522051
Date Prepared	:	5/22/97	Method Blank	:	FMB052297
FID Dilution Factor	:	NA			
PID Dilution Factor	:	50,000			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	220,000	200,000	ug/L
Toluene	108-88-3	5/23/97	1,100,000	200,000	ug/L
Ethyl Benzene	100-41-4	5/23/97	1,200,000	200,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/22/97	6,900,000 E	200,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		HI**		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

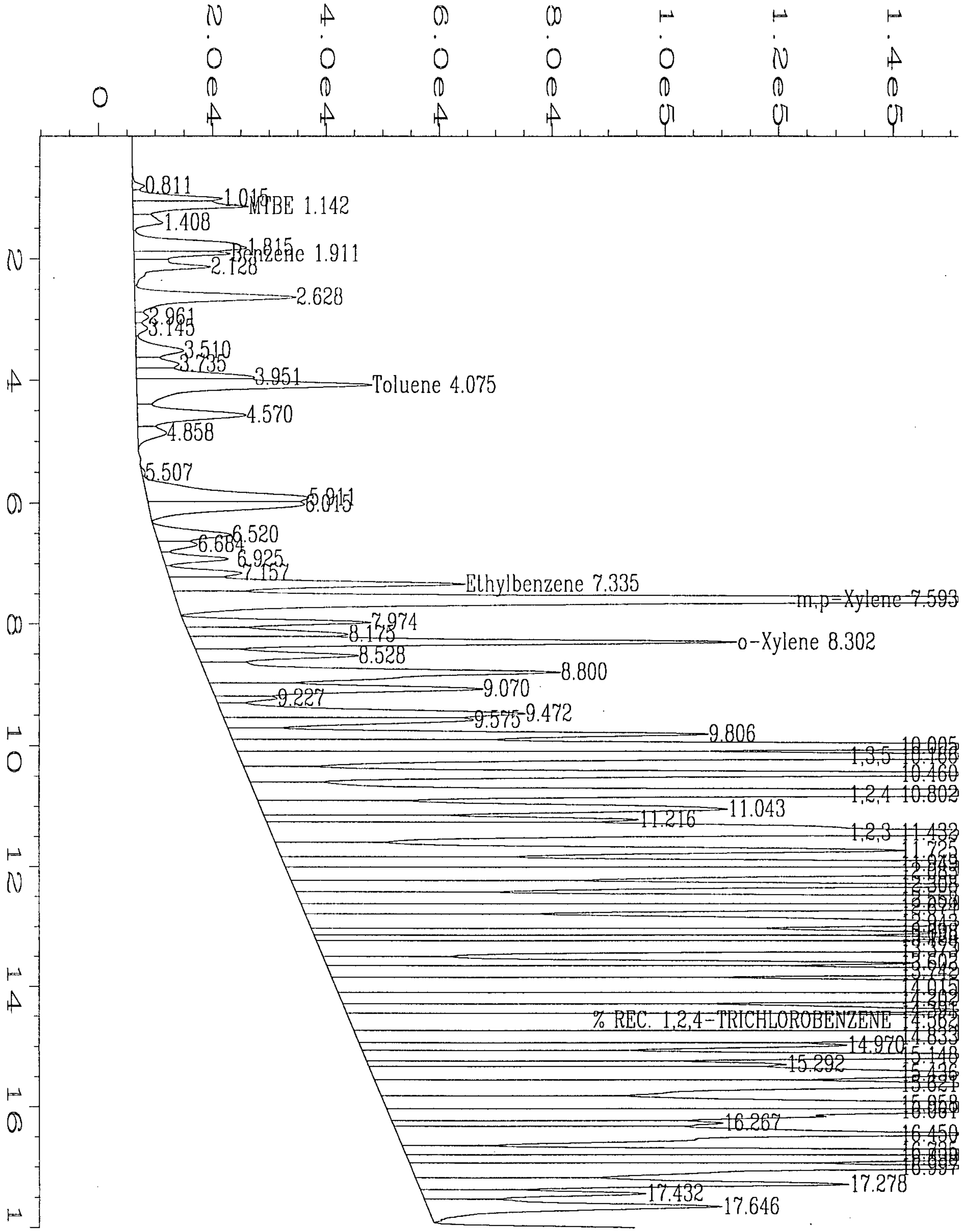
Comments: * of Fuel Weathering Study.
** High surrogate recovery due to hydrocarbon interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K/D Mills
Analyst

Approved



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Instrument : TVHBTEX1
Sample Name : 97-1841-02A1-F
un Time Bar Code:
cquired on : 23 May 97 07:09 PM
Report Created on: 23 May 97 07:28 PM
ast Recalib on : 01 APR 97 11:26 AM
ltiplier : 5e+004
Sample Info : SAMP BTEX_W
::SJMW2SFP; 10 ul of 1/100 Fuel extract

Page Number : 1
Vial Number : 51
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CH-W103	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-03	Lab Work Order	: 97-1841
Date Sampled	: 5/16/97	Matrix	: Fuel Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10522053
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 100,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/23/97	U	400,000	ug/L
Toluene	108-88-3	5/23/97	U	400,000	ug/L
Ethyl Benzene	100-41-4	5/23/97	960,000	400,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/23/97	5,400,000	400,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		120%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * of Fuel Weathering Study.

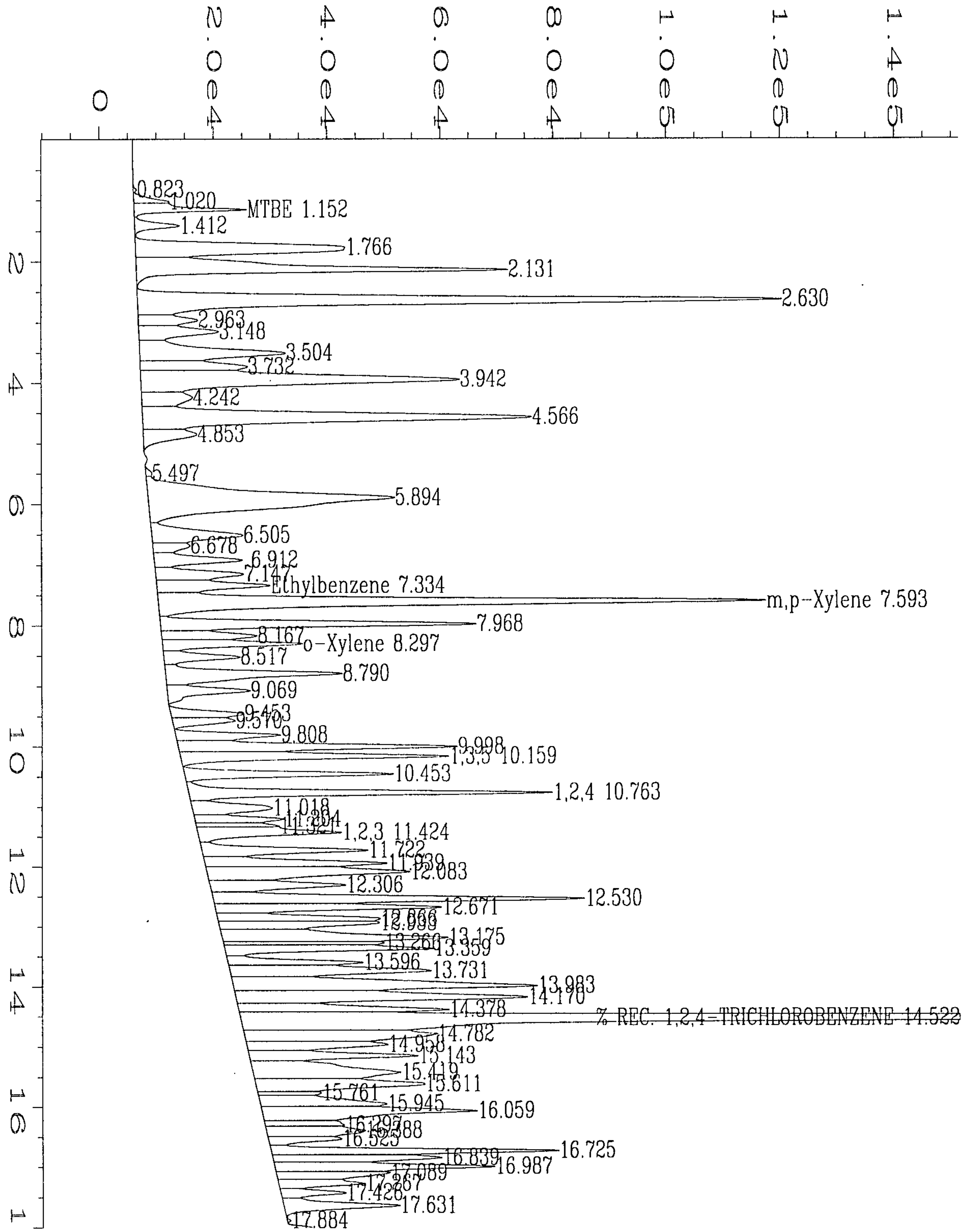
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

JDMills
Analyst

VTH
Approved

TVBXWS1;TV1841F.XLS; 5/29/97; 4



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Instrument	: TVHBTEX1	Vial Number	:	53	
Sample Name	: 97-1841-03A1-F	Injection Number	:	1	
Run Time Bar Code	:	Sequence Line	:	1	
Acquired on	: 23 May 97 08:16 PM	Instrument Method	:	TVH11216.MTH	
Report Created on	: 23 May 97 08:35 PM	Analysis Method	:	BX10331.MTH	
Last Recalib on	: 01 APR 97 11:26 AM	Sample Amount	:	0	
Multiplier	: 1e+005	ISTD Amount	:		
Sample Info	: SAMP BTEX_W				
	::CH-W103; 5 ul of 1/100 Fuel extract				

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CH-EW6	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-04	Lab Work Order	: 97-1841
Date Sampled	: 5/17/97	Matrix	: Fuel Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10527029
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 50,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/28/97	U	200,000	ug/L
Toluene	108-88-3	5/28/97	U	200,000	ug/L
Ethyl Benzene	100-41-4	5/28/97	U	200,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/28/97	2,100,000	200,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		119%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * of Fuel Weathering Study.

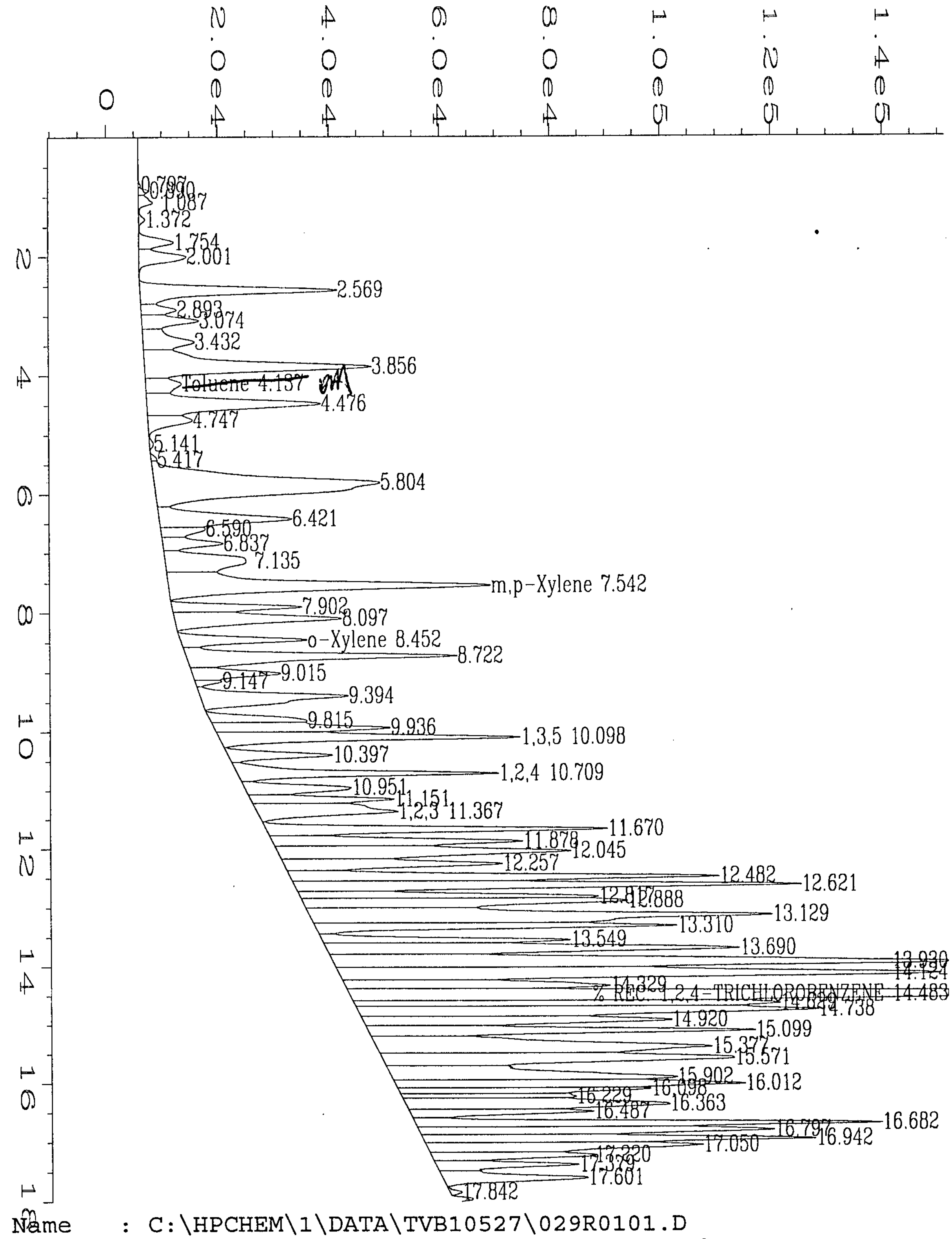
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H D Mills
Analyst

Approved

TVBXWS1;TV1841F.XLS; 5/29/97; 5



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Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : 97-1841-06 Fuel
Run Time Bar Code:
Acquired on : 28 May 97 00:55 AM
Report Created on: 28 May 97 09:37 AM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 5e+004
Sample Info : SAMP BTEX_Fuel
:: CH-EW6; 10 ul of 1/100 fuel extract

Page Number : 1
Vial Number : 29
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	Fresh JP-5 Sample	Client Project	:	Fuel Weathering Study
Lab Sample Number	:	97-1841-05	Lab Work Order	:	97-1841
Date Sampled	:	5/19/97	Matrix	:	Fuel Portion*
Date Received	:	5/21/97	Lab File Number(s)	:	TVB10527030
Date Prepared	:	5/22/97	Method Blank	:	FMB052297
FID Dilution Factor	:	NA			
PID Dilution Factor	:	20,000			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/28/97	U	80,000	ug/L
Toluene	108-88-3	5/28/97	36,000 J	80,000	ug/L
Ethyl Benzene	100-41-4	5/28/97	370,000	80,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/28/97	2,600,000	80,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		HI*		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * of Fuel Weathering Study.
** High surrogate recovery due to hydrocarbon interference.

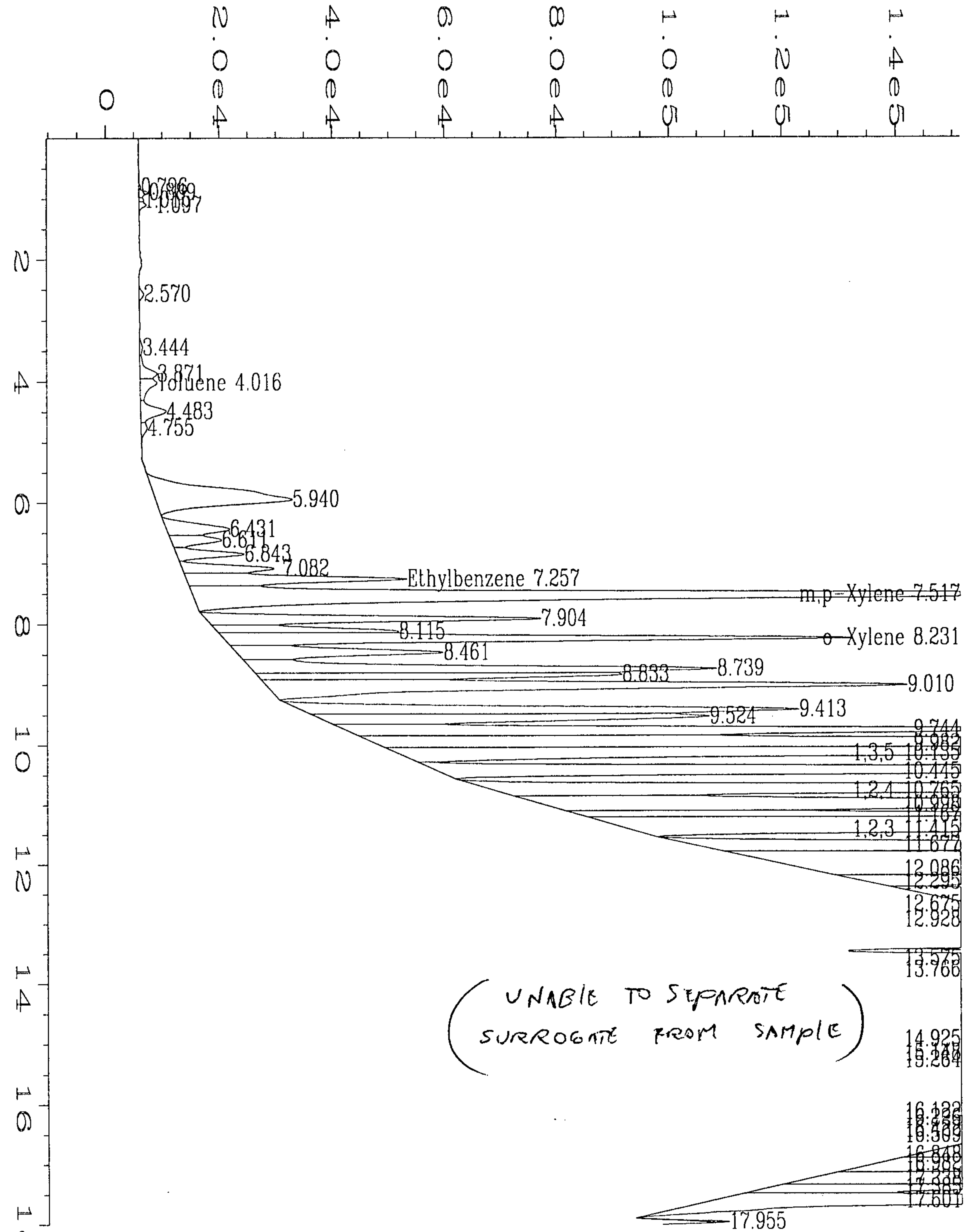
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

HDMills
Analyst

Approved

TVBXWS1;TV1841F.XLS; 5/29/97; 6



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Sample Name	: 97-1841-06F ~~Dup~~ 5	Injection Number	: 1
Run Time Bar Code	:	Sequence Line	: 1
Acquired on	: 28 May 97 01:28 AM	Instrument Method	: TVH11216.MTH
Report Created on	: 28 May 97 09:37 AM	Analysis Method	: BX10331.MTH
Last Recalib on	: 01 APR 97 11:26 AM	Sample Amount	: 0
Multiplier	: 2e+004	ISTD Amount	:
Sample Info	: SAMP BTEX_Fuel		
	:: Fresh JP-5; 25 ul of 1/100 fuel extract		

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CEF-293-9	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-06	Lab Work Order	: 97-1841
Date Sampled	: 5/20/97	Matrix	: Fuel Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10527031
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 100,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/28/97	U	400,000	ug/L
Toluene	108-88-3	5/28/97	U	400,000	ug/L
Ethyl Benzene	100-41-4	5/28/97	3,200,000	400,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/28/97	7,300,000	400,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		140%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

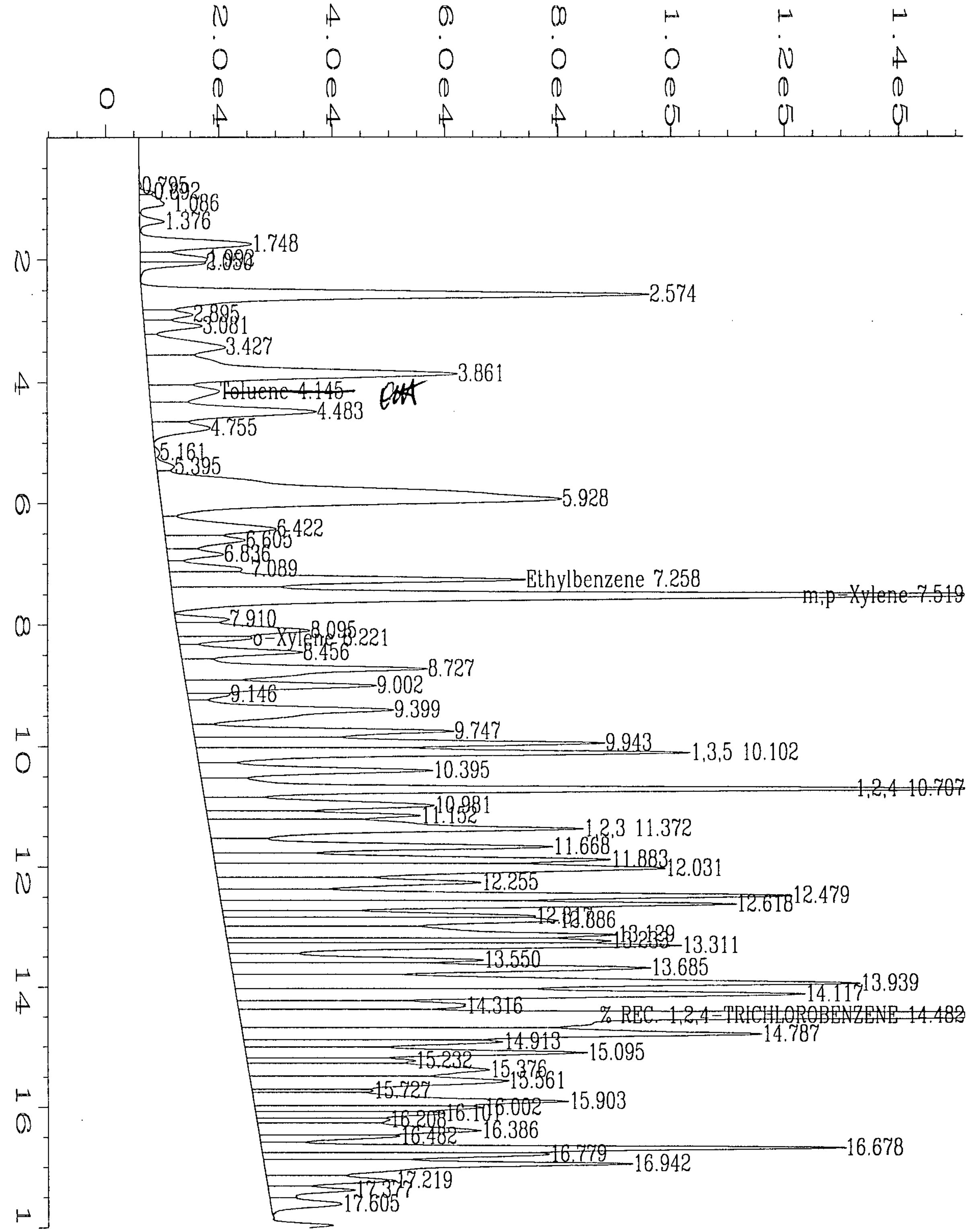
Comments: * of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

SD Mills
Analyst

Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10527\031R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : 97-1841-06 Fuel PM
Run Time Bar Code:
Acquired on : 28 May 97 02:01 AM
Report Created on: 28 May 97 09:38 AM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 1e+005
Sample Info : SAMP BTEX_Fuel
:: CEF-293-9; 5 ul of 1/100 fuel extract

Page Number : 1
Vial Number : 31
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: CEF-293-9	Client Project	: Fuel Weathering Study
Lab Sample Number	: 97-1841-06DUP	Lab Work Order	: 97-1841
Date Sampled	: 5/20/97	Matrix	: Fuel Portion*
Date Received	: 5/21/97	Lab File Number(s)	: TVB10527032
Date Prepared	: 5/22/97	Method Blank	: FMB052297
FID Dilution Factor	: NA		
PID Dilution Factor	: 100,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/28/97	U	400,000	ug/L
Toluene	108-88-3	5/28/97	U	400,000	ug/L
Ethyl Benzene	100-41-4	5/28/97	3,100,000	400,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/28/97	7,100,000	400,000	ug/L
FID Surrogate Recovery:		NA		50%-150%	(Limits)
PID Surrogate Recovery:		HI**		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

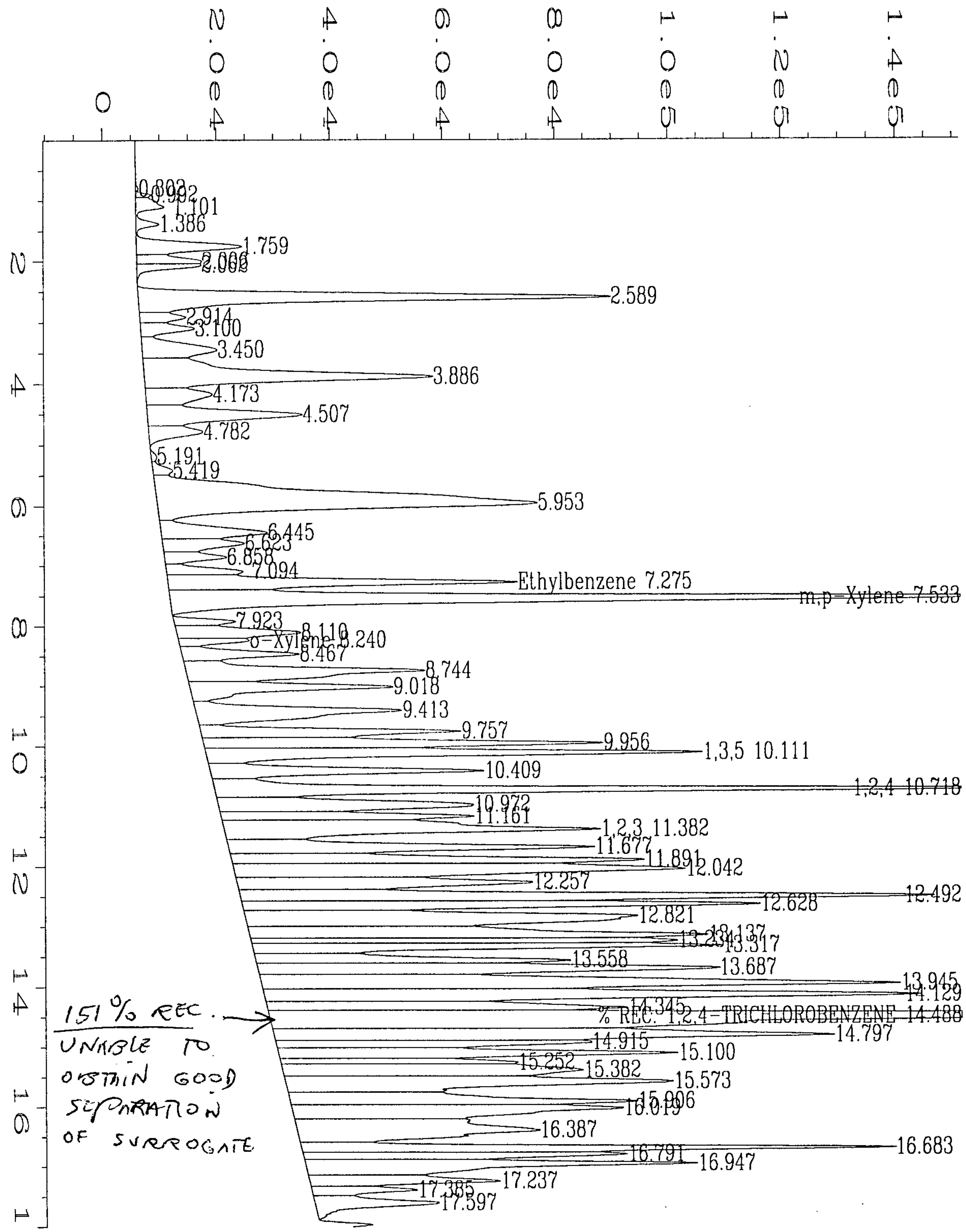
Comments: * of Fuel Weathering Study.
** High surrogate recovery due to hydrocarbon interference.

QUALIFIERS and DEFINITIONS:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

HDMills
Analyst

Approved

TVBXWS1;TV1841F.XLS; 5/29/97; 8



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Instrument : TVHBTEX1
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un Time Bar Code:
Acquired on : 28 May 97 02:35 AM
Report Created on: 28 May 97 09:39 AM
ast Recalib on : 01 APR 97 11:26 AM
ultiplier : 1e+005
Sample Info : SAMP BTEX_Fuel
:: CEF-293-9; 5 ul of 1/100 fuel extract Duplicate

Page Number : 1
Vial Number : 32
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	:	MEB1052297	Client Project	:	Fuel Weathering Study
Date Prepared	:	5/22/97	Lab Work Order	:	97-1841
Dilution Factor	:	125	Matrix	:	WATER/MEOH
			Lab File Number	:	TVB10522015

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/22/97	U	500	ug/kg
Toluene	108-88-3	5/22/97	U	500	ug/kg
Ethyl Benzene	100-41-4	5/22/97	U	500	ug/kg
Total Xylenes (m,p,o)	1330-20-7	5/22/97	U	500	ug/kg
FID Surrogate Recovery:		NA		50%-150%	(Limits)
PID Surrogate Recovery:		103%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

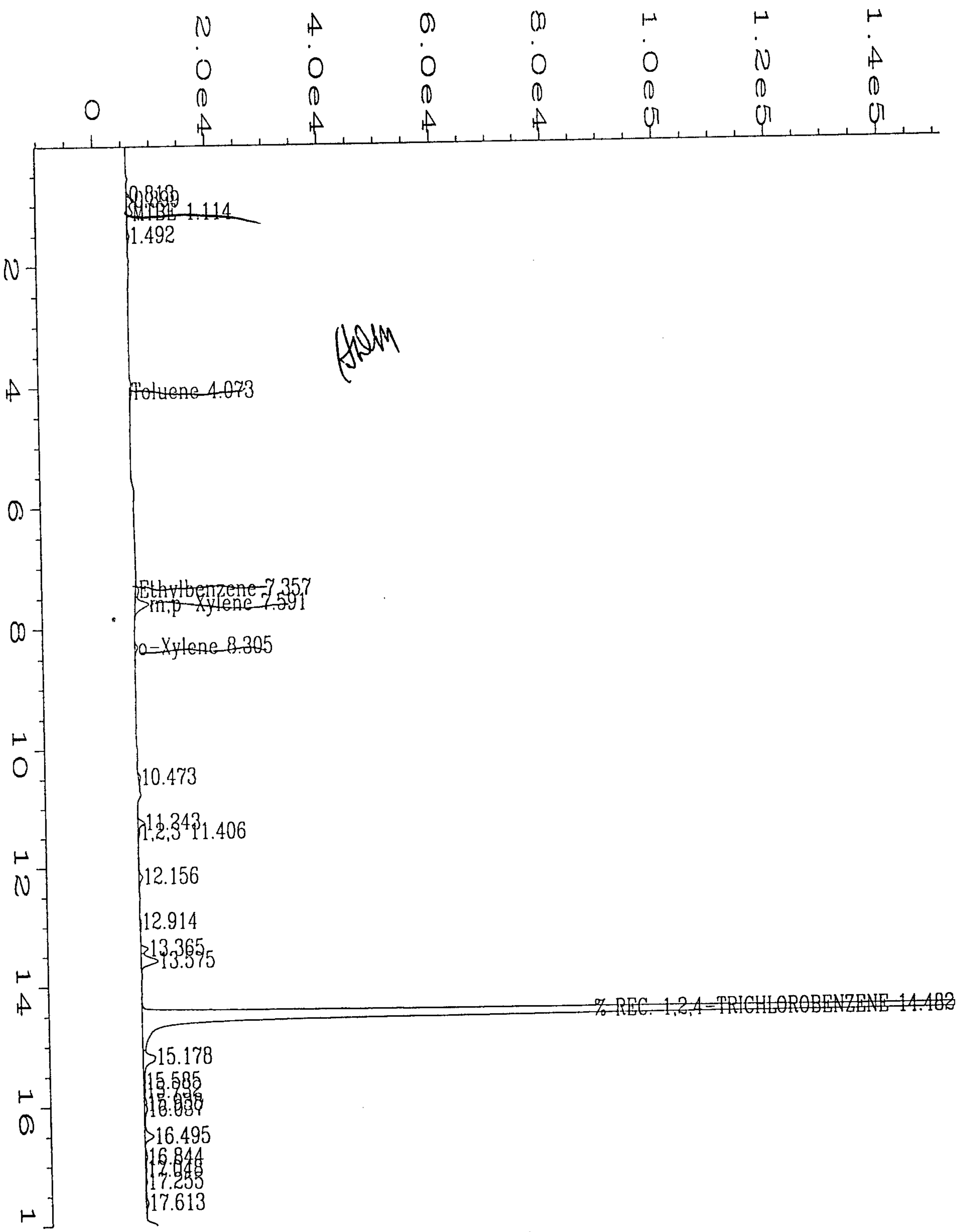
Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA =Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H. D. Mills
Analyst

Approved



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Instrument	: TVHBTEX1	Vial Number	:	15
Sample Name	: MEB1052297	Injection Number	:	1
un Time Bar Code:		Sequence Line	:	1
Acquired on	: 22 May 97 05:11 PM	Instrument Method:		TVH11216.MTH
Report Created on:	22 May 97 05:30 PM	Analysis Method	:	BX10331.MTH
ast Recalib on	: 01 APR 97 11:26 AM	Sample Amount	:	0
ultiplier	: 125	ISTD Amount	:	

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	:	FMB052297	Client Project	:	Fuel Weathering Study
Date Prepared	:	5/22/97	Lab Work Order	:	97-1841
Dilution Factor	:	1.0	Matrix	:	WATER
			Lab File Number	:	TVB10522017

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	5/22/97	U	0.4	ug/L
Toluene	108-88-3	5/22/97	U	0.4	ug/L
Ethyl Benzene	100-41-4	5/22/97	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	5/22/97	U	0.4	ug/L
FID Surrogate Recovery:	NA			78%-127%	(Limits)
PID Surrogate Recovery:		102%		76%-120%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

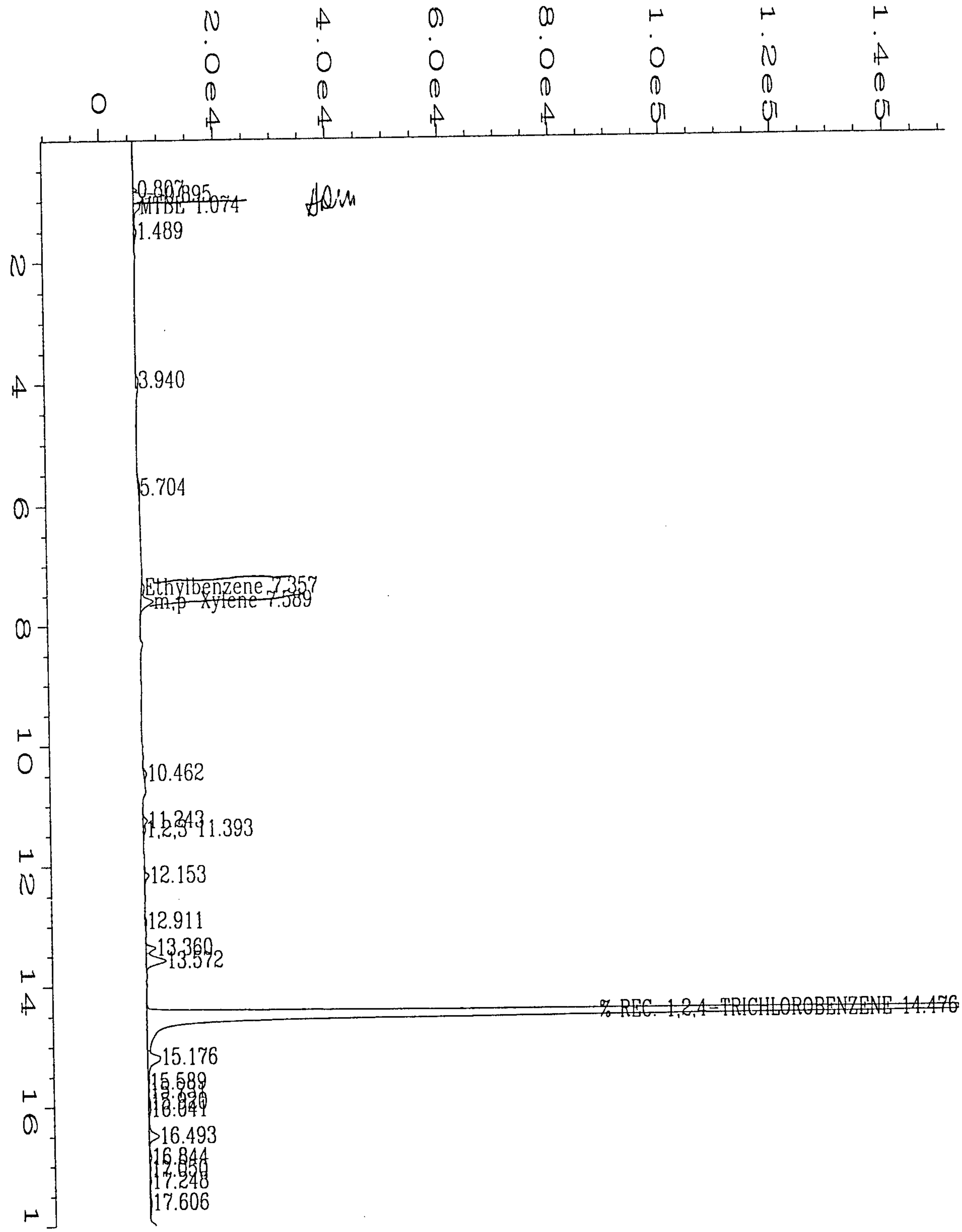
QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

NDMills
Analyst

[signature]
Approved

TVBXWS1;TV1841AQ.XLS; 5/29/97; 1



ata File Name : C:\HPCHEM\1\DATA\TVB10522\017R0101.D
perator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : FMB052297
un Time Bar Code:
cquired on : 22 May 97 06:18 PM
Report Created on: 22 May 97 06:37 PM
ast Recalib on : 01 APR 97 11:26 AM
ultiplier : 1
Sample Info :
::FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 17
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	: LCS1052297	Dilution Factor	: 1.00
Date Extracted/Prepared	: 5/22/97	Method	: 602/8020
Date Analyzed	: 5/22/97	Matrix	: Water
Spike Amount (ug/L)	: 20.0	Lab File No.	: TVB10522024
Instrument Name	: TVHBTEX1		

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
MTBE	1634-04-4	21.5	107.5	61 - 121
Benzene	71-43-2	20.3	101.5	76 - 109
Toluene	108-88-3	19.9	99.5	77 - 107
Chlorobenzene	108-90-7	19.5	97.5	71 - 102
Ethyl Benzene	100-41-4	20.0	100.0	76 - 109
m,p-Xylene	108-38-3 106-42-3	41.1	102.8	74 - 106
o-Xylene	95-47-6	20.8	104.0	76 - 112
1,3,5-Trimethylbenzene	108-67-8	19.9	99.5	70 - 106
1,2,4-Trimethylbenzene	95-63-6	18.6	93.0	74 - 101
1,2,3-Trimethylbenzene	526-73-8	21.6	108.0	87 - 123
1,2,3,4-Tetramethylbenzene	488-23-3	19.6	98.0	72 - 115
Surrogate Recovery:		108%		76 - 120

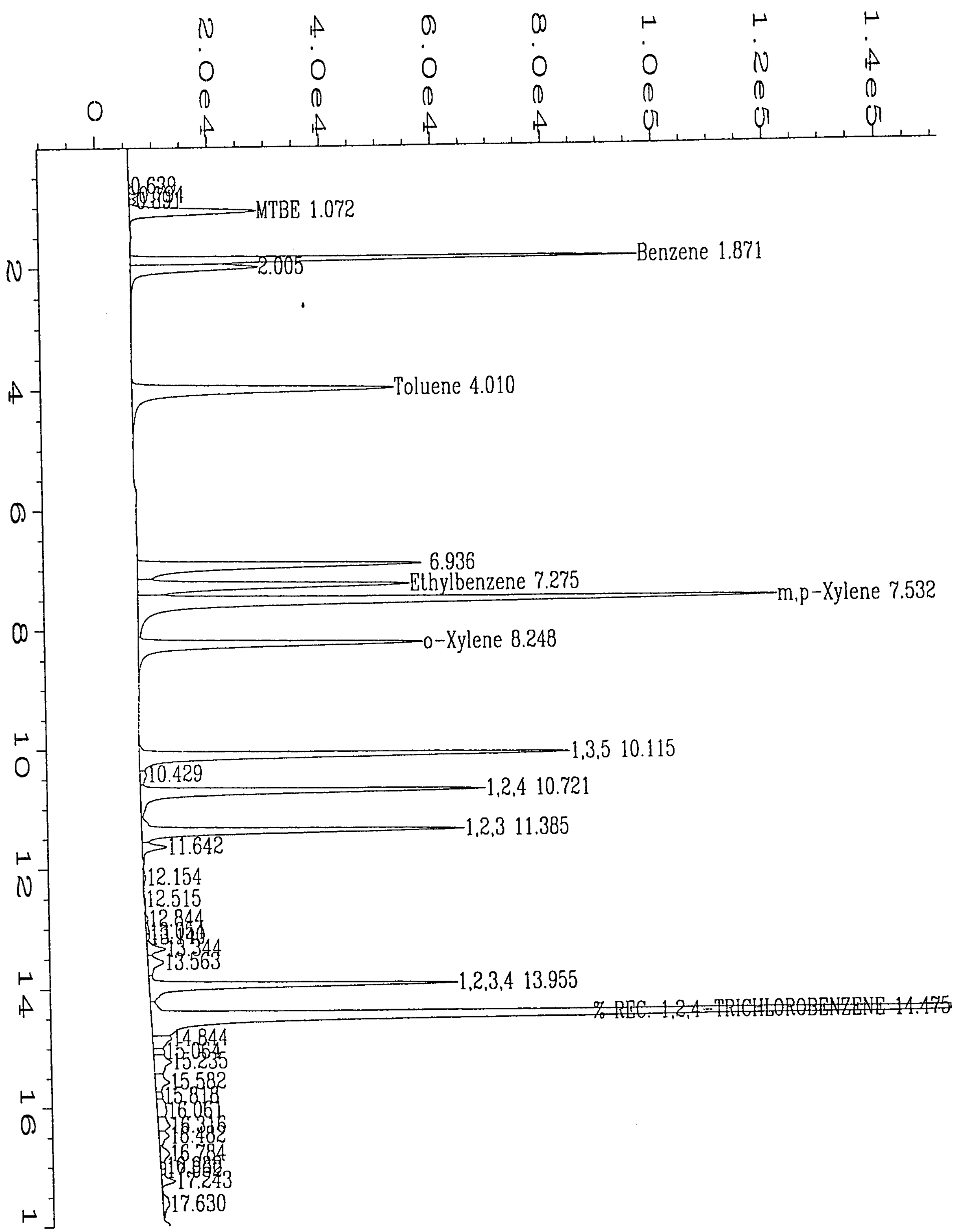
NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA = Not available/Not analyzed.
** = Compound limits updated 4/18/97, HDM, Water surrogate limits established 11/26/96, KSH.

HDaniels
Analyst

[signature]
Approved

LCSBXWS1;LSB10522.XLS; 5/27/97



ata File Name	:	C:\HPCHEM\1\DATA\TVB10522\024R0101.D
perator	:	H. D. Mills
Instrument	:	TVHBTEX1
ample Name	:	LCS1052297-BTEX
un Time Bar Code	:	
cquired on	:	22 May 97 10:11 PM
Report Created on	:	22 May 97 10:30 PM
ast Recalib on	:	01 APR 97 11:26 AM
ultiplier	:	1
Sample Info	:	#2036

Page Number	:	1
Vial Number	:	24
Injection Number	:	1
Sequence Line	:	1
Instrument Method	:	TVH11216.MTH
Analysis Method	:	BX10331.MTH
Sample Amount	:	0
ISTD Amount	:	

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	: LCS1052397	Dilution Factor	: 1.00
Date Extracted/Prepared	: 5/23/97	Method	: 602/8020
Date Analyzed	: 5/23/97	Matrix	: Water
Spike Amount (ug/L)	: 20.0	Lab File No.	: TVB10522038
Instrument Name	: TVHBTEX1		

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
MTBE	1634-04-4	18.9	94.5	61 - 121
Benzene	71-43-2	19.0	95.0	76 - 109
Toluene	108-88-3	18.5	92.5	77 - 107
Chlorobenzene	108-90-7	19.1	95.5	71 - 102
Ethyl Benzene	100-41-4	19.8	99.0	76 - 109
m,p-Xylene	108-38-3 106-42-3	38.4	96.0	74 - 106
o-Xylene	95-47-6	19.4	97.0	76 - 112
1,3,5-Trimethylbenzene	108-67-8	19.0	95.0	70 - 106
1,2,4-Trimethylbenzene	95-63-6	17.6	88.0	74 - 101
1,2,3-Trimethylbenzene	526-73-8	20.0	100.0	87 - 123
1,2,3,4-Tetramethylbenzene	488-23-3	18.7	93.5	72 - 115
Surrogate Recovery:		109%		76 - 120

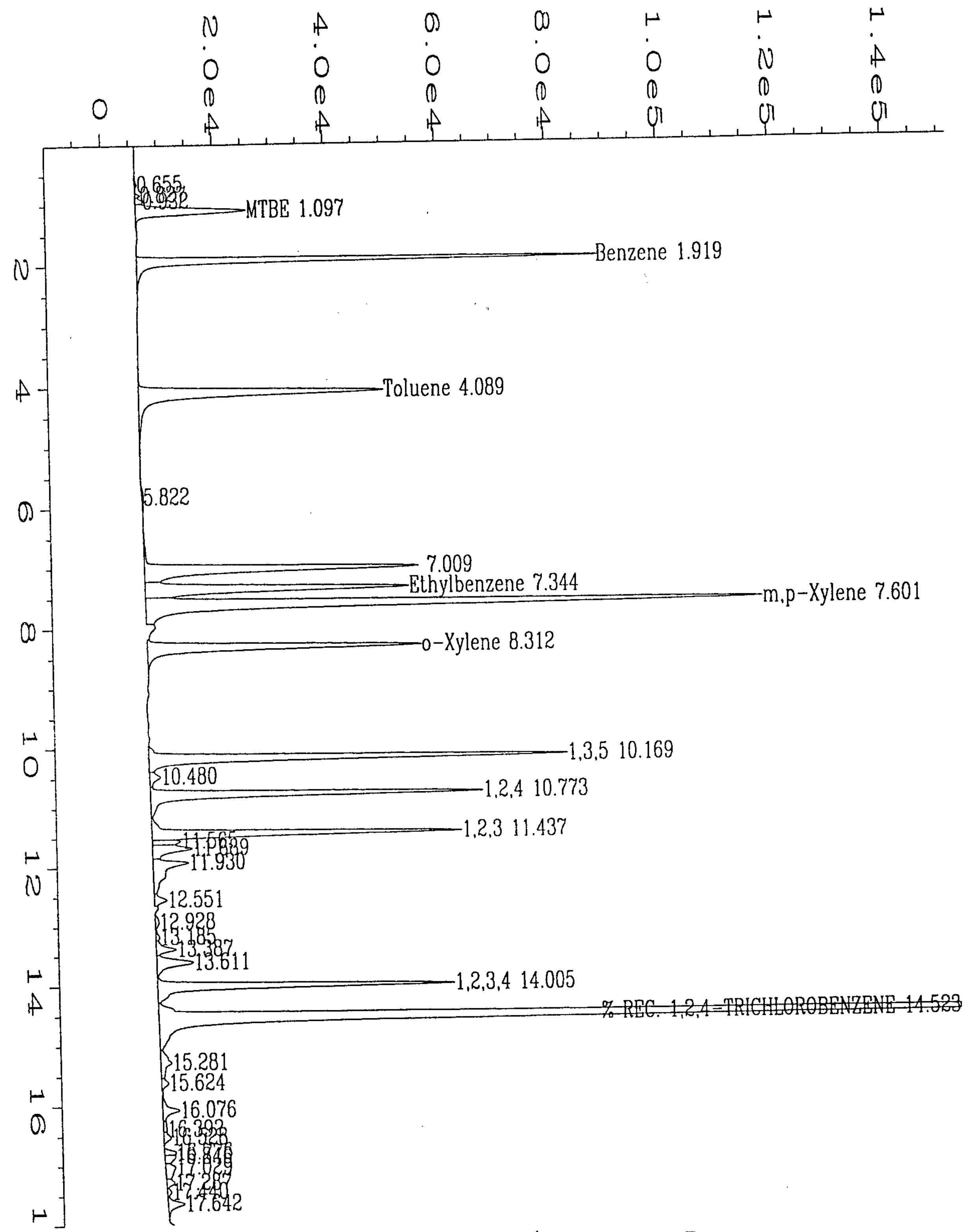
NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA = Not available/Not analyzed.
** = Compound limits updated 4/18/97, HDM, Water surrogate limits established 11/26/96, KSH.

Hdnulls
Analyst

Approved

LCSBXWS1;LSB10523.XLS; 5/27/97



Data File Name : C:\HPCHEM\1\DATA\TVB10522\038R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : LCS1052397-BTEX
Run Time Bar Code:
Acquired on : 23 May 97 11:54 AM
Report Created on: 23 May 97 12:13 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 1
Sample Info : #2036

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number : LCS1052797
Date Extracted/Prepared : 5/27/97
Date Analyzed : 5/27/97
Spike Amount (ug/L) : 20.0
Instrument Name : TVHBTEX1

Dilution Factor : 1.00
Method : 602/8020
Matrix : Water
Lab File No. : TVB10527026

Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
MTBE	1634-04-4	20.8	104.0	61 - 121
Benzene	71-43-2	19.4	97.0	76 - 109
Toluene	108-88-3	18.7	93.5	77 - 107
Chlorobenzene	108-90-7	18.3	91.5	71 - 102
Ethyl Benzene	100-41-4	19.2	96.0	76 - 109
m,p-Xylene	108-38-3 106-42-3	37.7	94.3	74 - 106
o-Xylene	95-47-6	19.4	97.0	76 - 112
1,3,5-Trimethylbenzene	108-67-8	18.6	93.0	70 - 106
1,2,4-Trimethylbenzene	95-63-6	17.2	86.0	74 - 101
1,2,3-Trimethylbenzene	526-73-8	19.9	99.5	87 - 123
1,2,3,4-Tetramethylbenzene	488-23-3	17.4	87.0	72 - 115
Surrogate Recovery:		107%		76 - 120

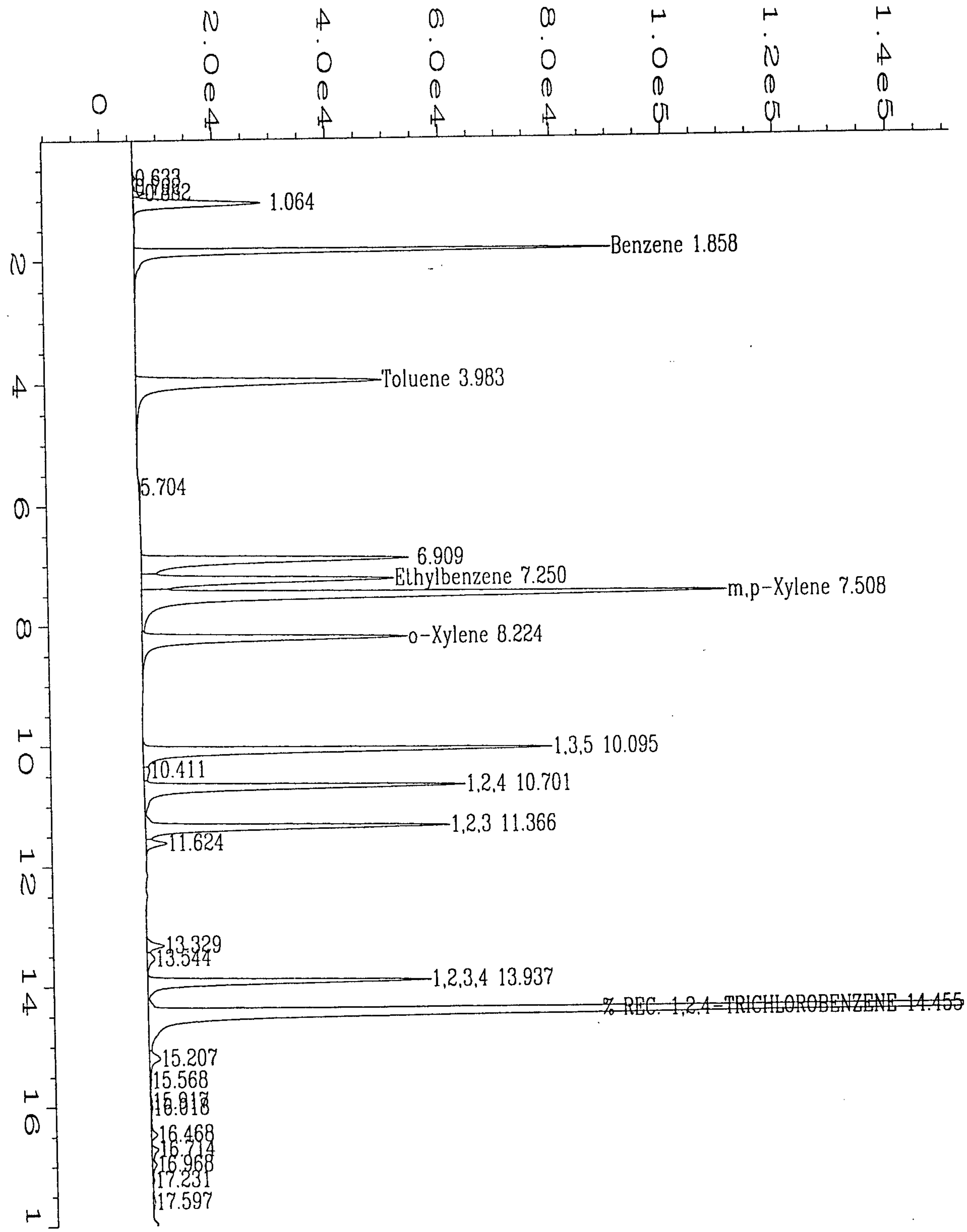
NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA = Not available/Not analyzed.
** = Compound limits updated 4/18/97, HDM, Water surrogate limits established 11/26/96, KSH.

Analyst

Approved

LCSBXWS1;LSB10527.XLS; 5/28/97



Data File Name : C:\HPCHEM\1\DATA\TVB10527\026R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : LCS1052797-BTEX
Run Time Bar Code:
Acquired on : 27 May 97 11:15 PM
Report Created on: 28 May 97 08:47 AM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 1

Page Number : 1
Vial Number : 26
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St.
Wheat Ridge, CO 80033
(303) 425-6021

EPA 602/8020 Data Report
Laboratory Control Sample (LCS)

LCS Number	: LCS1052897	Dilution Factor	: 1.00
Date Extracted/Prepared	: 5/28/97	Method	: 602/8020
Date Analyzed	: 5/28/97	Matrix	: Water
Spike Amount (ug/L)	: 20.0	Lab File No.	: TVB10527038
Instrument Name	: TVHBTEX1		

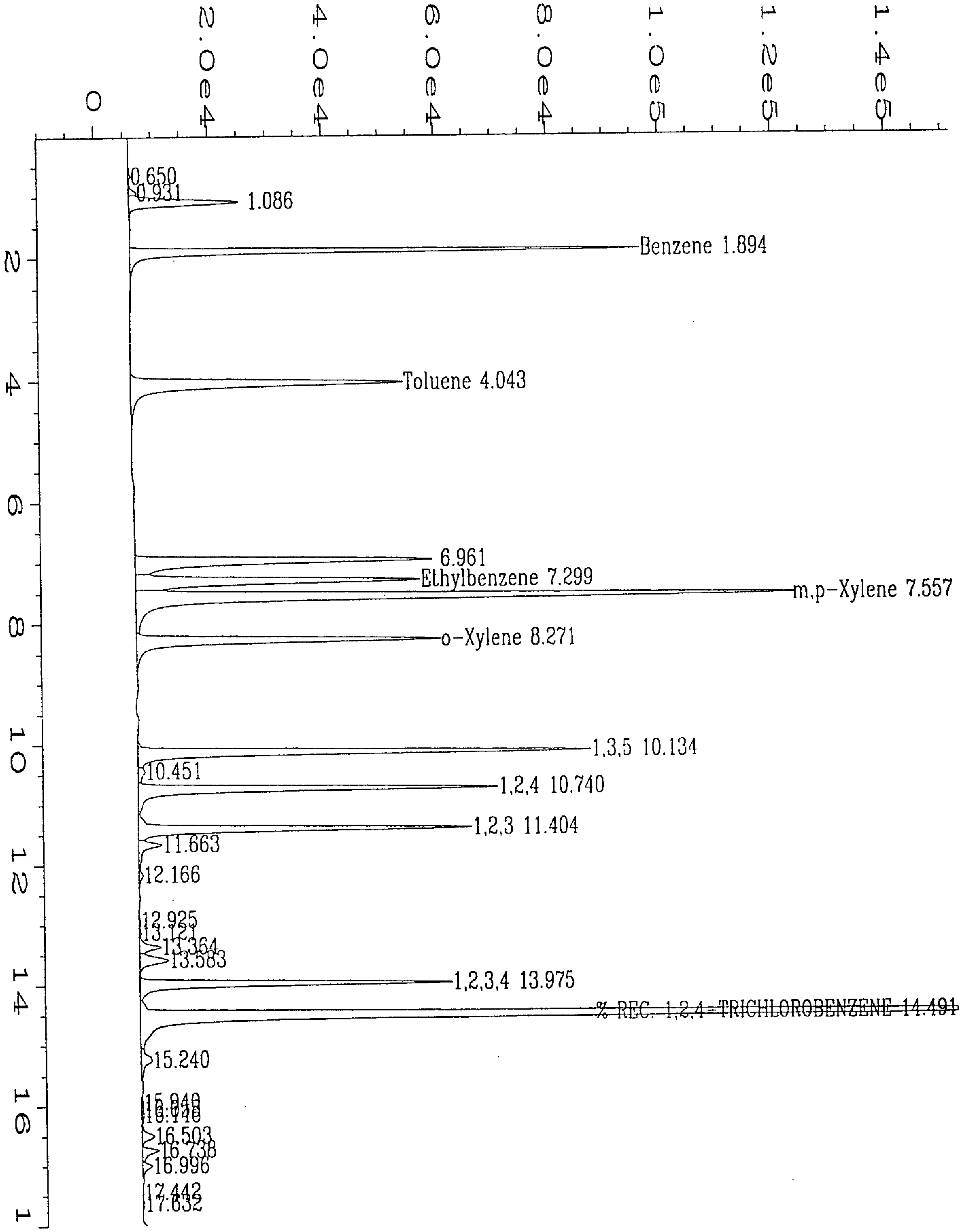
Compound Name	Cas Number	LCS Concentration (ug/L)	LCS % Recovery	QC Limit** % Recovery
MTBE	1634-04-4	17.8	89.0	61 - 121
Benzene	71-43-2	20.7	103.5	76 - 109
Toluene	108-88-3	20.3	101.5	77 - 107
Chlorobenzene	108-90-7	19.9	99.5	71 - 102
Ethyl Benzene	100-41-4	21.3	106.5	76 - 109
m,p-Xylene	108-38-3 106-42-3	41.7	104.3	74 - 106
o-Xylene	95-47-6	21.7	108.5	76 - 112
1,3,5-Trimethylbenzene	108-67-8	20.4	102.0	70 - 106
1,2,4-Trimethylbenzene	95-63-6	18.9	94.5	74 - 101
1,2,3-Trimethylbenzene	526-73-8	21.8	109.0	87 - 123
1,2,3,4-Tetramethylbenzene	488-23-3	18.9	94.5	72 - 115
Surrogate Recovery:		105%		76 - 120

NOTES: m,p-xylene = 40.0 ppb spike.

QUALIFIERS:
E = Extrapolated value. Value exceeds that of the calibration range.
U = Compound analyzed for, but not detected.
B = Compound found in blank and sample. Compare blank and sample data.
NA = Not available/Not analyzed.
** = Compound limits updated 4/18/97, HDM, Water surrogate limits established 11/26/96, KSH.

HDMills
Analyst

[signature]
Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10527\038R0101.D
Operator : H. D. Mills
Instrument : TVHBTEX1
Sample Name : LCS1052897-BTEX
Run Time Bar Code:
Acquired on : 28 May 97 12:36 PM
Report Created on: 28 May 97 12:54 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 1

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

Beaufort TFC

Evergreen
Analytical
Laboratory

August 27, 1997

CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY SUITE 900
DENVER, CO 80290

Work Order: 97-3156
Client Project: Fuel Weathering Study

Dear Craig Snyder:

Enclosed are the analytical results for the samples shown in the Work Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Carl Smits, Vice President of Quality Assurance.

SAMPLE DISPOSAL: Except for high level mercury (>260 ppm) samples, EAL will dispose of all samples one month from the date of this letter. If you want samples returned, please advise us by mail or fax as soon as possible.

RECORDS RETENTION: Effective January 1, 1996 we will retain a copy of this project report and supporting data for a period of three years. It has been our experience that a three year retention period is more than adequate to respond to client inquiries. If you want the project file sent to you after the three year period, please return a copy of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Jack Barney /cms

Jack Barney
President

PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

February 28, 1997

Ms. Patty McClellan
Evergreen Analytical, Inc.
4036 Youngfield
Wheat Ridge, CO 80033

Subject: Fuel/Water Partitioning Analyses for AFCEE Fuel Weathering Study

Dear Ms. McClellan:

The purpose of this letter is to explain the analyses requested from Evergreen Analytical Inc. (Evergreen) to support the Air Force Center for Environmental Excellence (AFCEE) Fuel Weathering study being performed by Parsons Engineering Science, Inc. (Parsons ES). The primary objective of the study is to determine an average range of natural weathering (degradation) rates for fuels released to the subsurface environment. A secondary objective is to determine fuel/water partition coefficients (K_{fw}) at equilibrium saturations. We are hopeful that Evergreen can support us in evaluating fuel/water partitioning.

Determination of K_{fw}'s for gasoline/water mixtures was performed by Cline et al (1991) (see attached). For their study, saturated, equilibrium solutions of gasolines in contact with distilled, deionized, organic-free water were prepared. Two milliliters (mL) of fuel were added to 40 mL of water in VOA vials having Teflon-septa (a 1:20 fuel to water ratio). Samples were mixed on a rotating disk apparatus for 30 minutes at $22 \pm 1°C$. The vials were then allowed to sit undisturbed for 1 hour in an inverted position. From each VOA bottle, the separated water phase was removed through the septum at the bottom of the VOA bottle using a 5-mL syringe. The extracted water phase was then stored in 2-mL crimp seal vials and refrigerated until gas chromatography with flame ionization detection (GC/FID) could be performed.

We wish to follow the same basic procedures as the Cline et al study; however, we would like for both the aqueous phase and the organic (fuel) phase to be analyzed individually following the 30 minute rotation and 1 hour inverted stabilization. We request that each phase be analyzed for determination of benzene, toluene, ethylbenzene, and total xylenes (BTEX) concentrations by USEPA SW8020 by gas chromatography with photoionization detection (GC/PID). Concentrations should be reported in milligrams per liter (mg/L). Our fuel weathering study will look at a variety of fuels (JP-4, JP-5, JP-8 jet fuels and gasoline) collected from ten separate sites. We anticipate submitting to Evergreen either one or two fuel samples per site with one duplicate being submitted for every five sites sampled. We understand that the cost for analysis will be $60.00 for the aqueous phase and $85.00 for the organic phase. Depending upon whether one or two samples are submitted per site, we anticipate that between 12 and 22 fuel samples total will be sent to Evergreen for analysis as part of the study.

We also are submitting fuel samples to the USEPA National Risk Management Research Laboratory (NRMRL) in Ada, Oklahoma and to the Arthur D. Little Laboratory in Cambridge, Massachusetts for other fuel analyses. If possible, we would like to obtain from Evergreen approximately 36 20-mL VOA bottles to support sample collection and submission to the various labs.

At present, seven sites have been selected for the study. During the week of March 3, 1997, we will be collecting samples from the first two sites and anticipate sending to Evergreen two to five fuel samples for analysis as described above. Sampling of the other five sites is likely to occur during one or two separate mobilizations during the Spring/early Summer of 1997. Hopefully, we will be able to identify three other sites to include in the study and sample later this year.

The analytical procedures we have described above are subject to change following review of this letter and the attachment by Evergreen and by Mr. Doug Downey, our Technical Director for the study. Next week, we will have to confirm with you the exact procedures to be followed before analyzing the first round of samples. If you have any questions or comments, please feel free to contact me at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Craig B. Snyder

Craig B. Snyder
Task Manager

Enclosures

cc: D. Downey
D. Moutoux
M. Vessely
File

Evergreen Analytical, Inc.

97-3156

WORK ORDER Summary

27-Aug 11:20 am

Report To: Craig Snyder

Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Client Project ID: Fuel Weathering Study

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments: Analyze both aqueous and organic phase after separation. Return unused portion of sample to client.

QC Level: Laboratory Standard QC

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
97-3156-01A	BFT-401-3	BTEX		Organic	2	12-Aug-97	13-Aug-97	27-Aug-97	26-Aug-97
97-3156-01B		BTEX		Water				27-Aug-97	19-Aug-97

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

FAX RESULTS Y / N

COMPANY: Parsons ES
ADDRESS: 1700 Broadway, Suite 900
CITY: Denver STATE: CO ZIP: 80290
PHONE#: 303-831-8100 FAX #: 303-831-8208

CLIENT CONTACT (print): Craig Snyder
PROJECT I.D.: Fuel Weathering Study
EAL. QUOTE #: P.O.# 729641.35730
TURNAROUND REQUIRED*: ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify)
*expedited turnaround subject to additional fee

Sampler Name:
(signature): ~~Frank~~ Craig B. Dyk for
(print): Frank Araico

Evergreen Analytical Cooler No.
Cooler Received

Please **PRINT** all information:

EAL use only
Do not write in shaded area

WO# 97-3156 BOF# n/A BY JD
C/S(o) NA NA C/S(I) NA / HD
Temp°C 25 Seals Intact Y/N/NA
Pres Y/N/NA Hd Sp Y/N/NA
Loc 10 Cont 40 ✓

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: ~~Oil / Sludge~~ JP-5 Jet Fuel	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	EAL Sample No.
BFT-401-3	12Aug97	1030	1											X						01
HT:														A						Location 2
DD:														40v						Container Size 40v

Instructions: Analyze IAW Feb 28, 1997 letter from Parsons ES to Patty McClellan
Analyze ~~B~~ organic & aqueous phase following laboratory separation
* Do not analyze aqueous phase submitted in VOA bottle sample *

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Dyk	8/13/97 1135	[illegible]	8/13/97 1135				

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID	: BFT-401-3		
Lab Sample ID	: 97-3156-01A	**Client Project ID**	: Fuel Weathering Study
Date Collected	: 08/12/97	**Lab Work Order**	: 97-3156
Date Received	: 08/13/97	**Sample Matrix**	: Organic

Method: SW8020A **BTEX**

Date Prepared	: 08/26/97	**Lab File ID**	: TVB10826\023R0101.D	**Effective Dilution**	: 20000
Date Analyzed	: 08/26/97	**Method Blank**	: FWS082697		

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	80000	µg/L
Toluene	108-88-3	20000 J	80000	µg/L
Ethylbenzene	100-41-4	160000	80000	µg/L
m,p-Xylene	1330-20-7	680000	80000	µg/L
o-Xylene	95-47-6	330000	80000	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	0% S X	50 - 150	**QC Limits**

Comments: X = Poor surrogate recovery due to coelution of interference.

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

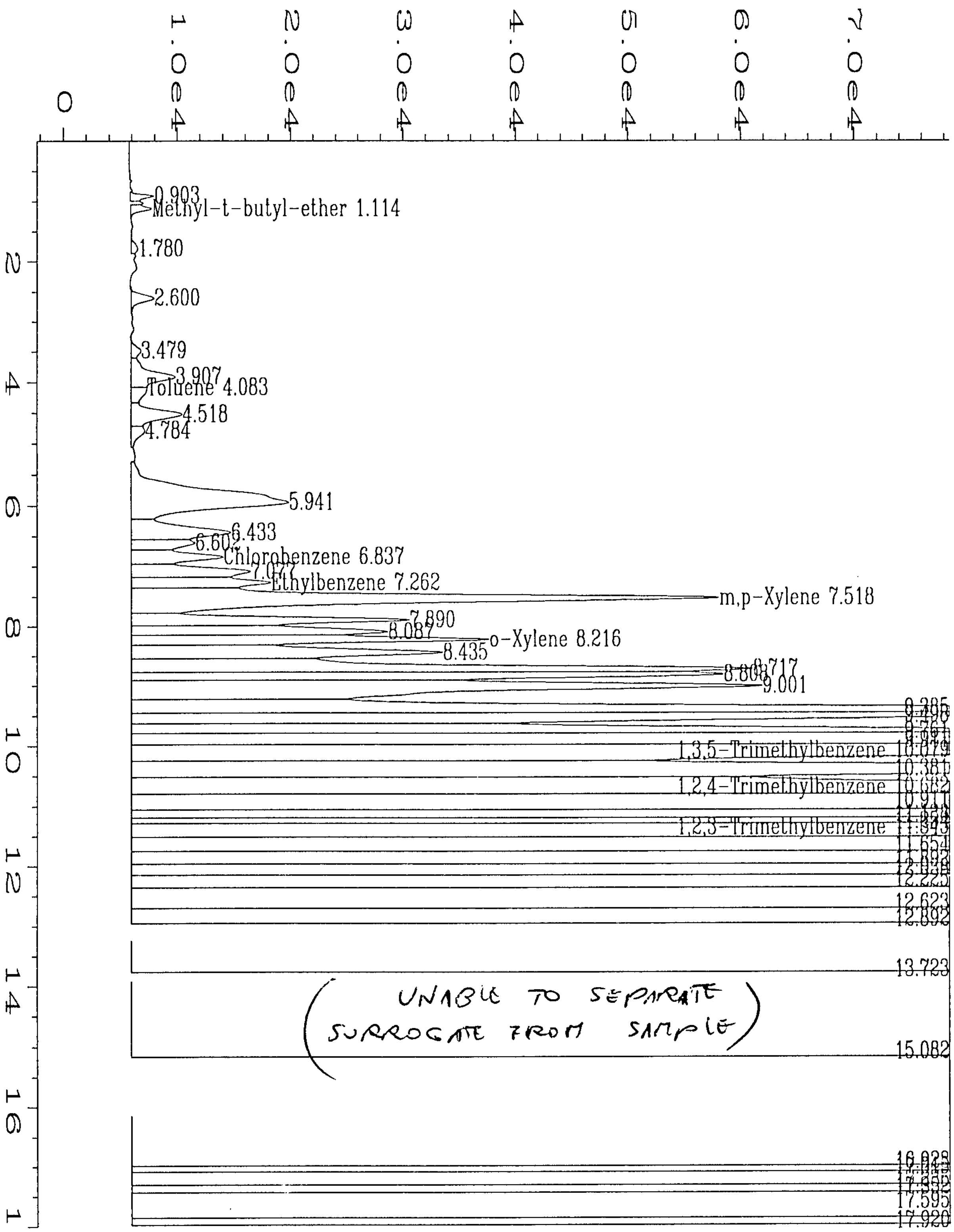
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

8/27/97 11:44:14 AM



Data File Name	: C:\HPCHEM\1\DATA\TVB10826\023R0101.D		
Operator	: H.DIANE MILLS	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 23
Sample Name	: 97-3156-01A	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 1
Acquired on	: 26 Aug 97 10:05 PM	Instrument Method:	TVH11216.MTH
Report Created on:	27 Aug 97 09:48 AM	Analysis Method	: BX10814A.MTH
Last Recalib on	: 14 AUG 97 02:36 PM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:
Sample Info	: SAMP TVH_O BTEX_O		

BFT-401-3; 0.25 UL OF 1/1 FUEL WEATHERING STUDY (FUEL)
DF=20000

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : BFT-401-3
Lab Sample ID : 97-3156-01B
Date Collected : 08/12/97
Date Received : 08/13/97

Client Project ID : Fuel Weathering Study
Lab Work Order : 97-3156
Sample Matrix : Water

Method: SW8020A — **BTEX**

Date Prepared : 08/26/97
Date Analyzed : 08/26/97
Lab File ID : TVB10826\021R0101.D
Method Blank : FWS082697
Effective Dilution : 20

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	8	µg/L
Toluene	108-88-3	16	8	µg/L
Ethylbenzene	100-41-4	35	8	µg/L
m,p-Xylene	1330-20-7	140	8	µg/L
o-Xylene	95-47-6	130	8	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	104%	50 - 150	**QC Limits**

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

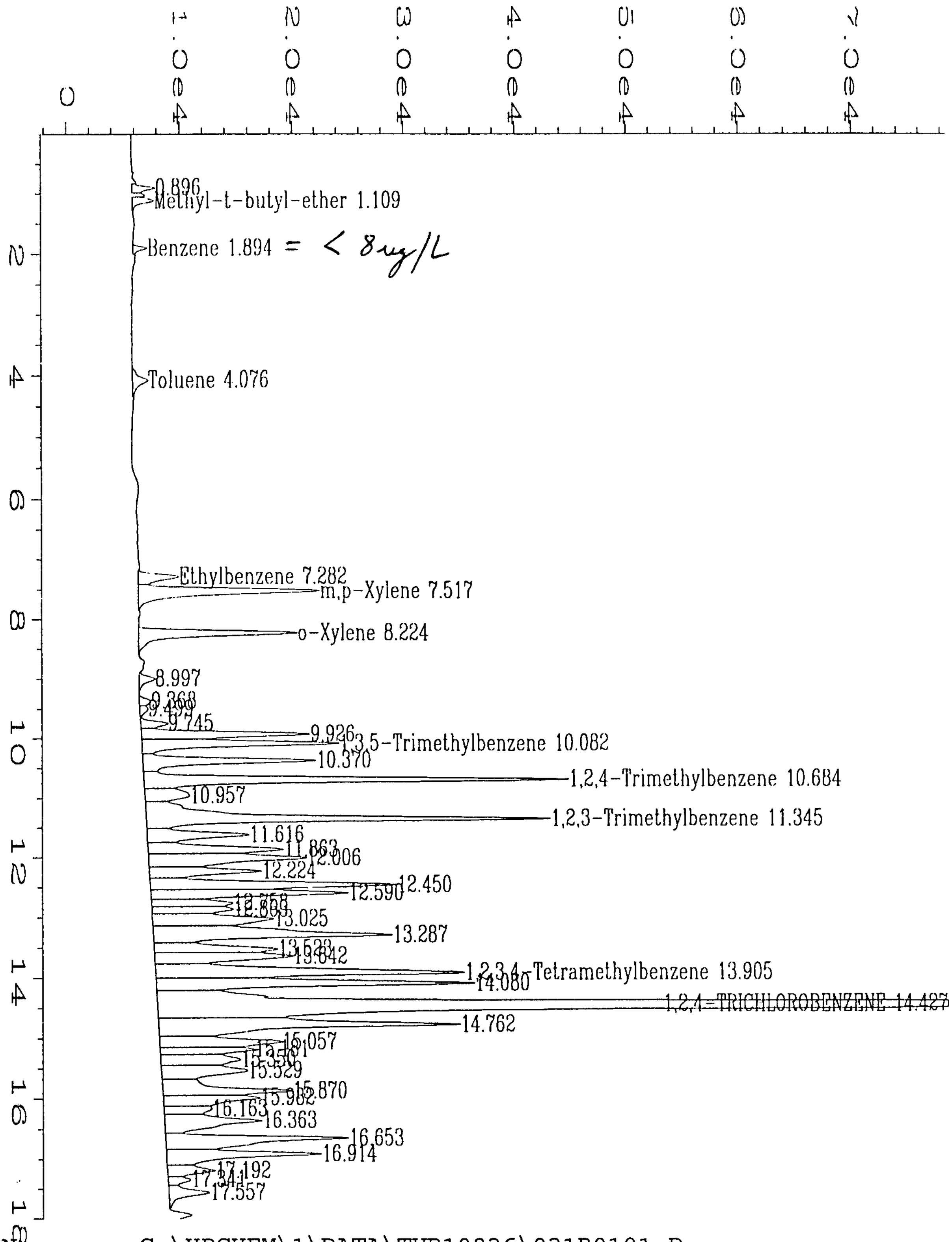
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

8/27/97 11:44:18 AM



Data File Name : C:\HPCHEM\1\DATA\TVB10826\021R0101.D

Operator	: H.DIANE MILLS	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 21
Sample Name	: 97-3156-01A	Injection Number	: 1
Run Time Bar Code	:	Sequence Line	: 1
Acquired on	: 26 Aug 97 09:02 PM	Instrument Method	: TVH11216.MTH
Report Created on	: 26 Aug 97 09:21 PM	Analysis Method	: BX10814A.MTH
Last Recalib on	: 14 AUG 97 02:36 PM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:

Sample Info : SAMP TVH_W BTEX_W
BFT-401-3; 0.250 ML WATER FUEL WEATHERING STUDY (AQUEOUS)
DF=20

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Method Blank Data Report

Lab Work Order : 97-3156 **Client Project ID :** Fuel Weathering Study
Lab Sample ID : FWS082697

Method: SW8020A **BTEX**

Date Prepared : 08/26/97 **Lab File ID** : TVB10826\008R0101.D **Effective Dilution** : 1
Date Analyzed : 08/26/97

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	99%	50 - 150	**QC Limits**

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

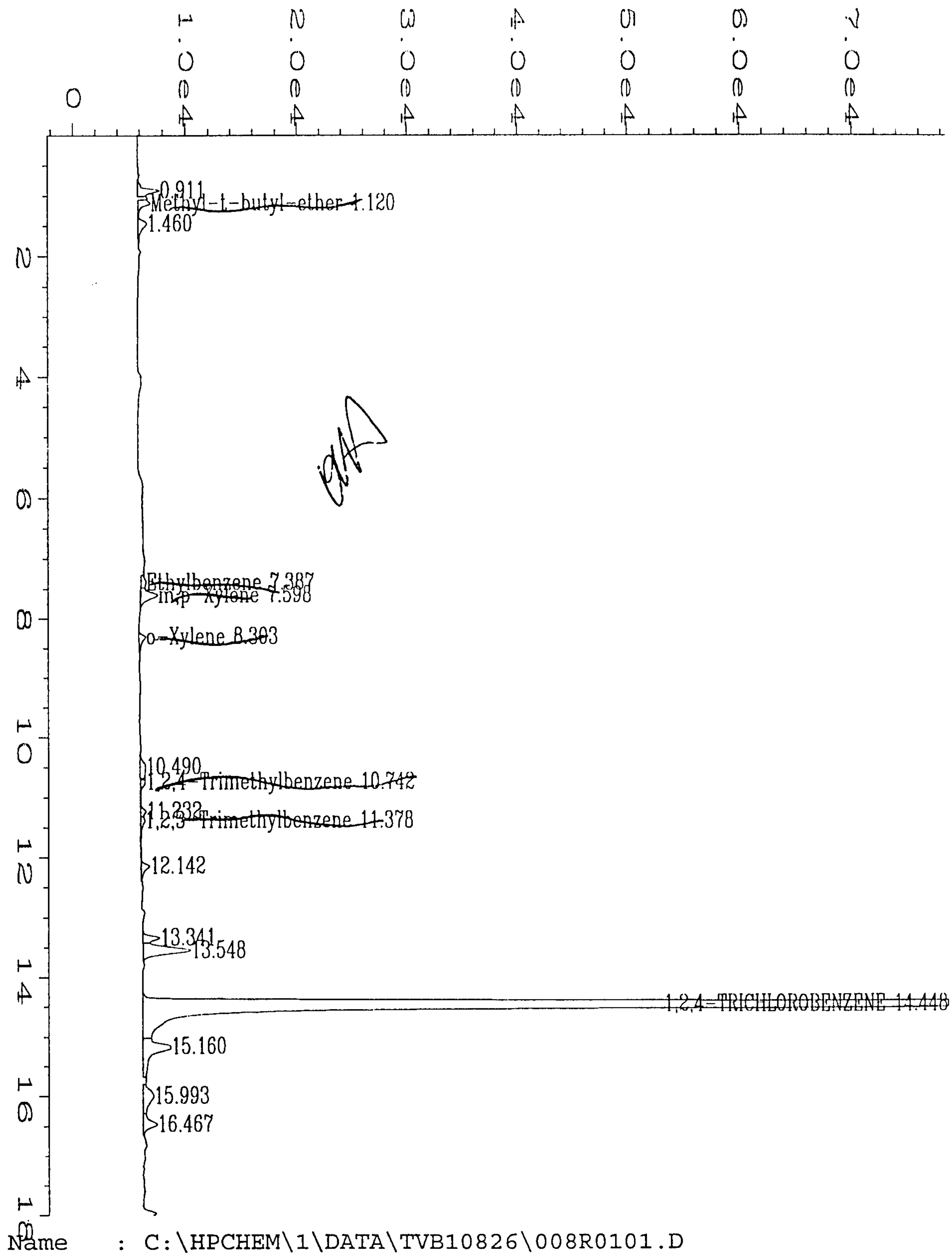
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst Approved

8/27/97 10:39:13 AM



Data File Name : C:\HPCHEM\1\DATA\TVB10826\008R0101.D

Operator	: H.DIANE MILLS	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 8
Sample Name	: FWS082697	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 1
Acquired on	: 26 Aug 97 02:00 PM	Instrument Method:	TVH11216.MTH
Report Created on:	26 Aug 97 02:19 PM	Analysis Method	: BX10814A.MTH
Last Recalib on	: 14 AUG 97 02:36 PM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:
Sample Info	: MBLK TVH_W BTEX_W		

Evergreen Analytical, Inc **Date:** *27-Aug-97*

CLIENT: Parsons Engineering Science
Work Order: 97-3156
Project: Fuel Weathering Study

QC SUMMARY REPORT
Laboratory Control Spike - generic

Sample ID: **LCS1081997-BTEX** Batch ID: **TVHBTEX1_9** Test Code: **SW8020A** Units: **µg/L** Run ID: **TVHBTEX1_970826A** Prep Date: **8/26/97**
Client ID: Matrix: **Water** Seq No: **9983** Analysis Date: **8/26/97 5:54:00 PM**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl-t-butyl-ether	22.43	1.6	20	ND	112.1%	50	150		0.0%	0	
Benzene	21.53	0.4	20	ND	107.6%	50	150		0.0%	0	
Toluene	21.51	0.4	20	ND	107.6%	50	150		0.0%	0	
Ethylbenzene	22.67	0.4	20	ND	113.4%	50	150		0.0%	0	
m,p-Xylene	44.88	0.4	40	ND	112.2%	50	150		0.0%	0	
o-Xylene	21.7	0.4	20	ND	108.5%	50	150		0.0%	0	
1,2,4-Trichlorobenzene	97.54	0	100	ND	97.5%	50	150		0.0%	0	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
E - Analyte detected above calibration limits
B - Analyte detected in the associated Method Blank
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits

Evergreen
Analytical
Laboratory

Eakir

September 15, 1997

CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY SUITE 900
DENVER, CO 80290

Work Order: 97-3397
Client Project: Fuel Weathering Study

Dear Craig Snyder:

Enclosed are the analytical results for the samples shown in the Work Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Carl Smits, Vice President of Quality Assurance.

SAMPLE DISPOSAL: Except for high level mercury (>260 ppm) samples, EAL will dispose of all samples one month from the date of this letter. If you want samples returned, please advise us by mail or fax as soon as possible.

RECORDS RETENTION: Effective January 1, 1996 we will retain a copy of this project report and supporting data for a period of three years. It has been our experience that a three year retention period is more than adequate to respond to client inquiries. If you want the project file sent to you after the three year period, please return a copy of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Jack Barney /cms

Jack Barney
President

Evergreen Analytical, Inc. 4036 Youngfield St. Wheat Ridge, CO 80033-3862 (303) 425-6021 FAX (303) 425-6854

Evergreen Analytical, Inc.

97-3397

WORK ORDER Summary

11-Sep 02:42 pm

Report To: Craig Snyder

Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Client Project ID: Fuel Weathering Study

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments: Return unused portion of sample to client.

QC Level: Laboratory Standard QC

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
97-3397-01A	EAKMW316-FP	BTEX		Organic	10	27-Aug-97	29-Aug-97	15-Sep-97	10-Sep-97
97-3397-01B		BTEX		Water				15-Sep-97	03-Sep-97

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

Parsons

COMPANY Craig B. Snyder

ADDRESS 1700 Broadway, Suite 900

CITY Denver STATE CO ZIP 80290-0900

PHONE# 303-~~42~~ 831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

CLIENT CONTACT (print) Craig Snyder

PROJECT I.D. Fuel Weathering Study

EAL. QUOTE # ______ P.O.# 729691.35730

TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day)

☐ Other (Specify) ______

*expedited turnaround subject to additional fee

Sampler Name:
(signature) [signature]
(print) Christopher Papierniak USACE

Evergreen Analytical Cooler No. ______

Cooler Received ______

Please **PRINT** all information:

Spill Site No. 2 Eaker AFB

EAL use only
Do not write in shaded area

WO# 97-3397 BOF# n/a BY SD
C/S(o) n/a / n/a C/S(I) C / Co
Temp°C 4 Seals Intact Y/N/NA
Pres Y/N/NA? Hd Sp Y/N/NA
Loc 2 Cont 20V

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: JP-4 Free Product	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	EAL Sample No.
EAKMW316-FP	27Aug97	1220	1			X								X						-01A

HT:

DD:

Location 2

Container Size 20V

Instructions: Analyze IAW Feb 28, 1997 letter from Parsons ES to Patty McClellan
Analyze organic & aqueous phases following laboratory ~~separation~~ addition of distilled, ~~water~~ deionized water & separation

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	8-28-97/0800					[signature]	8/29/97 1100

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : EAKMW316-FP
Lab Sample ID : 97-3397-01A
Date Collected : 08/27/97
Date Received : 08/29/97

Client Project ID : Fuel Weathering Study
Lab Work Order : 97-3397
Sample Matrix : Organic

Method: SW8020A — **BTEX**

Date Prepared : 09/10/97 **Lab File ID** : TVB10910\022R0101.D **Effective Dilution** : 650000
Date Analyzed : 09/10/97 **Method Blank** : FWS1091097B

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	2000000 J	2600000	µg/L
Toluene	108-88-3	1000000 J	2600000	µg/L
Ethylbenzene	100-41-4	5500000	2600000	µg/L
m,p-Xylene	1330-20-7	22000000	2600000	µg/L
o-Xylene	95-47-6	4300000	2600000	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		83%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

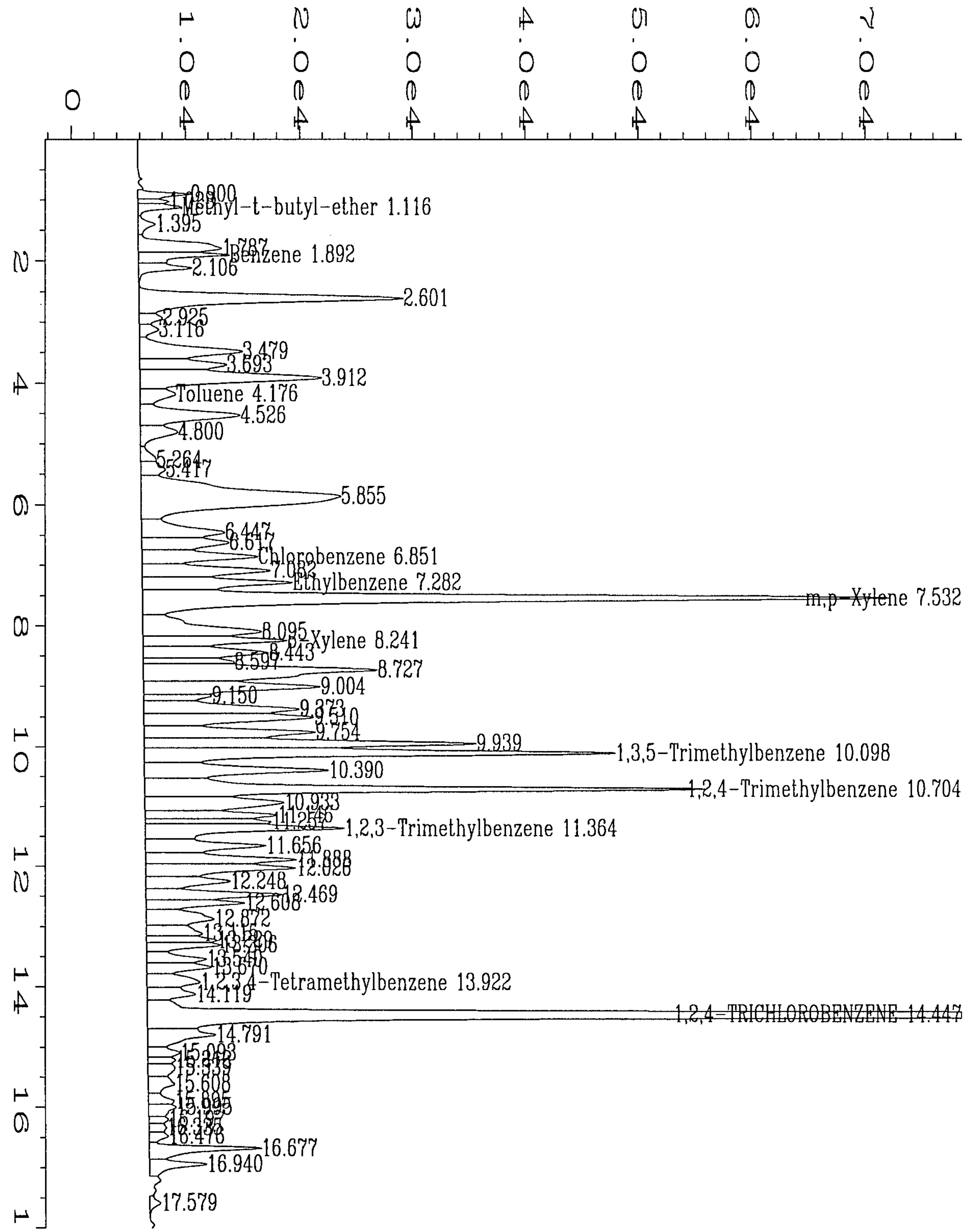
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

9/15/97 10:23:37 AM



ata File Name	:	C:\HPCHEM\1\DATA\TVB10910\022R0101.D			
perator	:	H. DIANE MILLS	Page Number	:	1
Instrument	:	TVHBTEX1	Vial Number	:	22
ample Name	:	97-3397-01A	Injection Number	:	1
un Time Bar Code	:		Sequence Line	:	1
Acquired on	:	10 Sep 97 08:45 PM	Instrument Method	:	TVH11216.MTH
Report Created on	:	10 Sep 97 09:04 PM	Analysis Method	:	BX10814A.MTH
ast Recalib on	:	14 AUG 97 02:36 PM	Sample Amount	:	0
ultiplier	:	1	ISTD Amount	:	
Sample Info	:	SAMP TVH_O BTEX_O			

EAKMW316-FP; 8.0 UL OF 1/1000 FUEL WEATHERING STUDY (FUEL PORTION)

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : EAKMW316-FP
Lab Sample ID : 97-3397-01B
Date Collected : 08/27/97
Date Received : 08/29/97

Client Project ID : Fuel Weathering Study
Lab Work Order : 97-3397
Sample Matrix : Water

Method: SW8020A — **BTEX**

Date Prepared : 09/10/97
Date Analyzed : 09/10/97
Lab File ID : TVB10910\020R0101.D
Method Blank : FWS1091097B
Effective Dilution : 125

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	5200	50	µg/L
Toluene	108-88-3	U	50	µg/L
Ethylbenzene	100-41-4	1000	50	µg/L
m,p-Xylene	1330-20-7	4600	50	µg/L
o-Xylene	95-47-6	1000	50	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	82%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

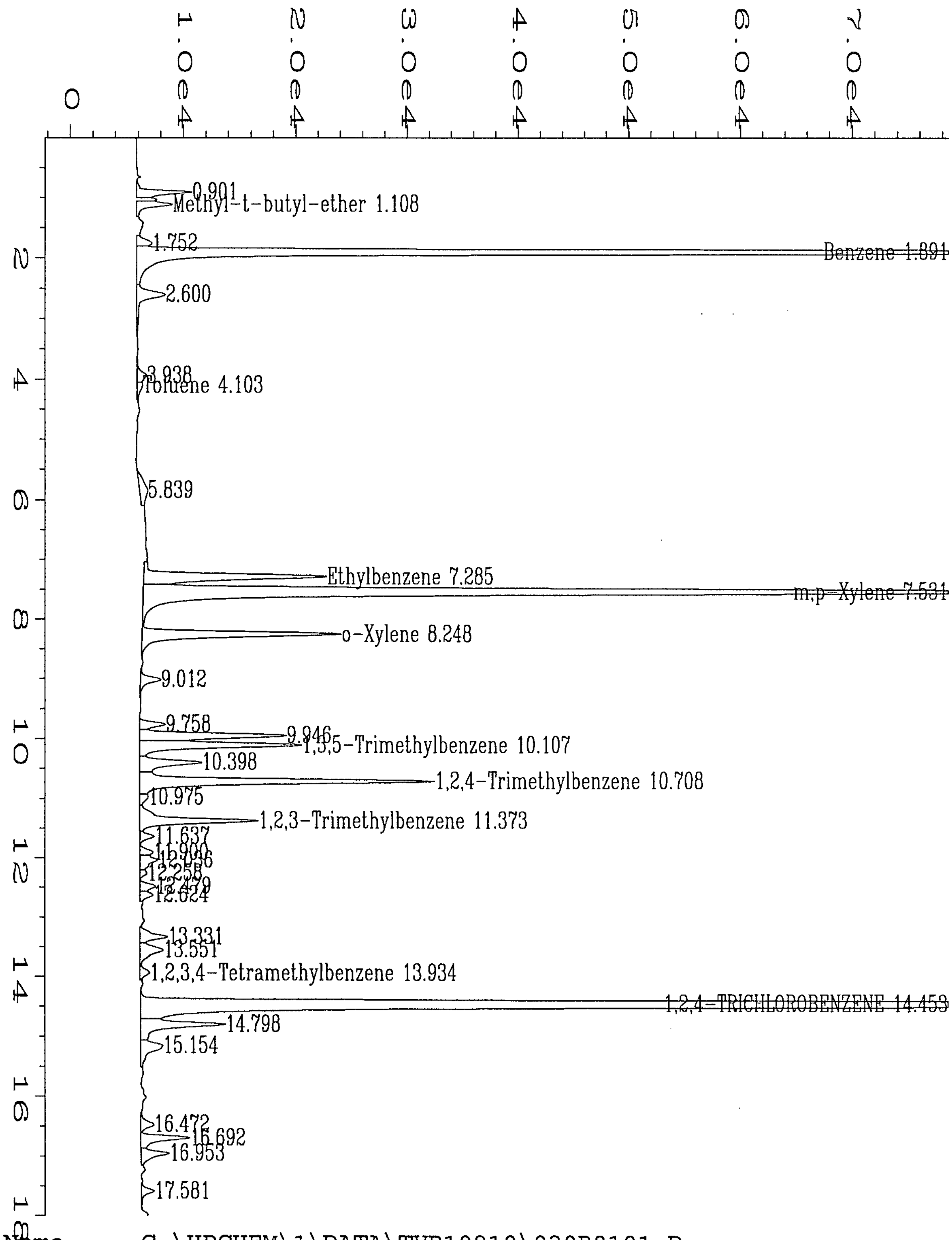
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

9/11/97 3:04:09 PM



ata File Name	: C:\HPCHEM\1\DATA\TVB10910\020R0101.D		
perator	: H. DIANE MILLS	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 20
ample Name	: 97-3397-01B	Injection Number	: 1
un Time Bar Code:		Sequence Line	: 1
Acquired on	: 10 Sep 97 07:44 PM	Instrument Method:	TVH11216.MTH
Report Created on:	10 Sep 97 08:03 PM	Analysis Method	: BX10814A.MTH
ast Recalib on	: 14 AUG 97 02:36 PM	Sample Amount	: 0
ultiplier	: 1	ISTD Amount	:
Sample Info	: SAMP TVH_W BTEX_W		

EAKMW316-FP; 40 UL FUEL WEATHERING STUDY (AQUEOUS)

DF=125

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Method Blank Data Report

Lab Work Order : 97-3397
Client Project ID : Fuel Weathering Study
Lab Sample ID : FWS1091097B

Method: SW8020A **BTEX +**

Date Prepared : 09/10/97 **Lab File ID** : TVB10910\019R0101.D **Effective Dilution** : 1
Date Analyzed : 09/10/97

Compound Name	CAS Number	Concentration	RL	Units
MTBE	1634-04-4	U	1.6	µg/L
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	81%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

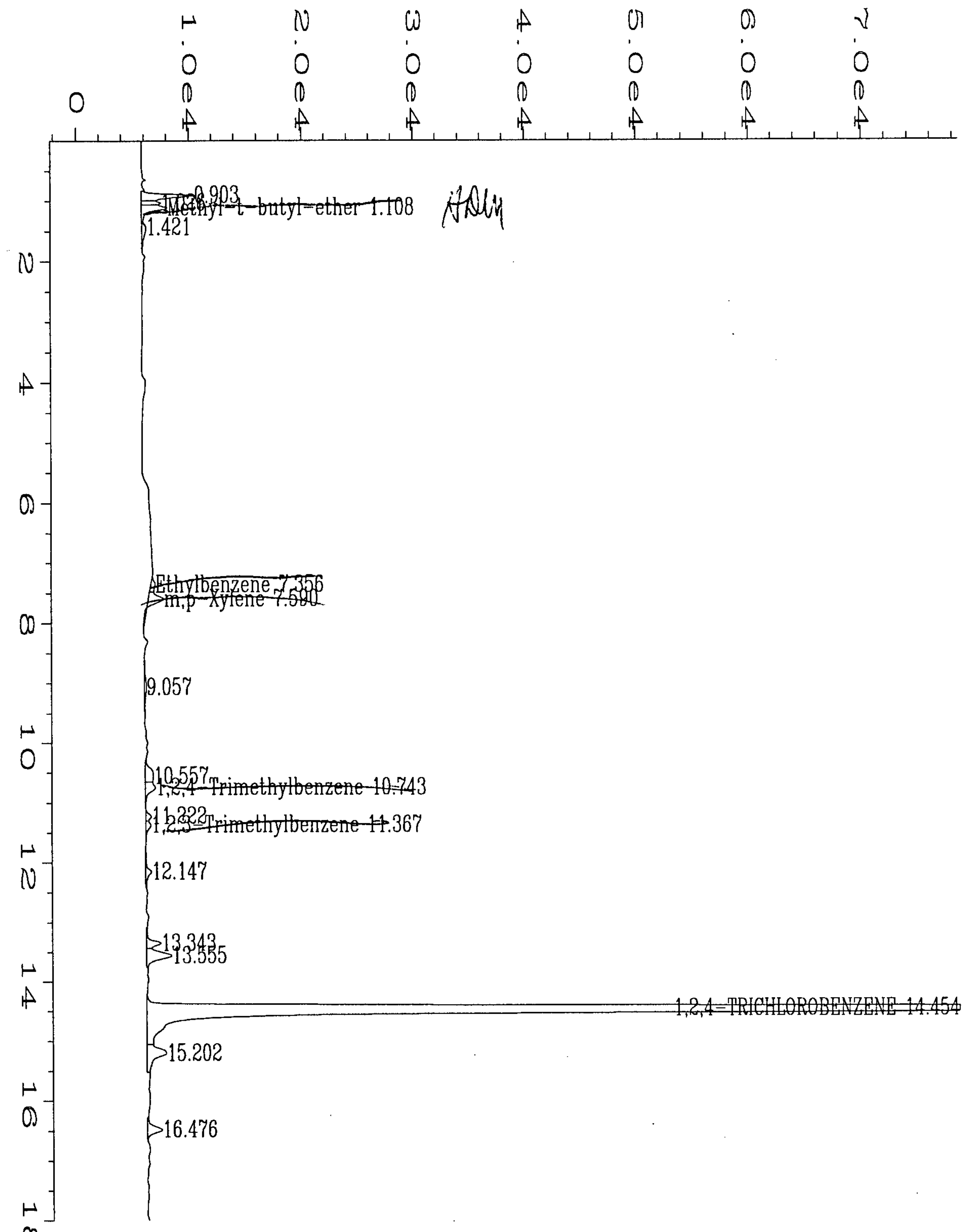
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

9/11/97 3:04:15 PM



Data File Name	: C:\HPCHEM\1\DATA\TVB10910\019R0101.D		
Operator	: H. DIANE MILLS	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 19
Sample Name	: FWS1091097B	Injection Number	: 1
Run Time Bar Code	:	Sequence Line	: 1
Acquired on	: 10 Sep 97 07:14 PM	Instrument Method	: TVH11216.MTH
Report Created on	: 11 Sep 97 10:21 AM	Analysis Method	: BX10814A.MTH
Last Recalib on	: 14 AUG 97 02:36 PM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:
Sample Info	: MBLK TVH_W BTEXM_W		

Evergreen Analytical, Inc **Date:** *11-Sep-97*

CLIENT: Parsons Engineering Science
Work Order: 97-3397
Project: Fuel Weathering Study

QC SUMMARY REPORT

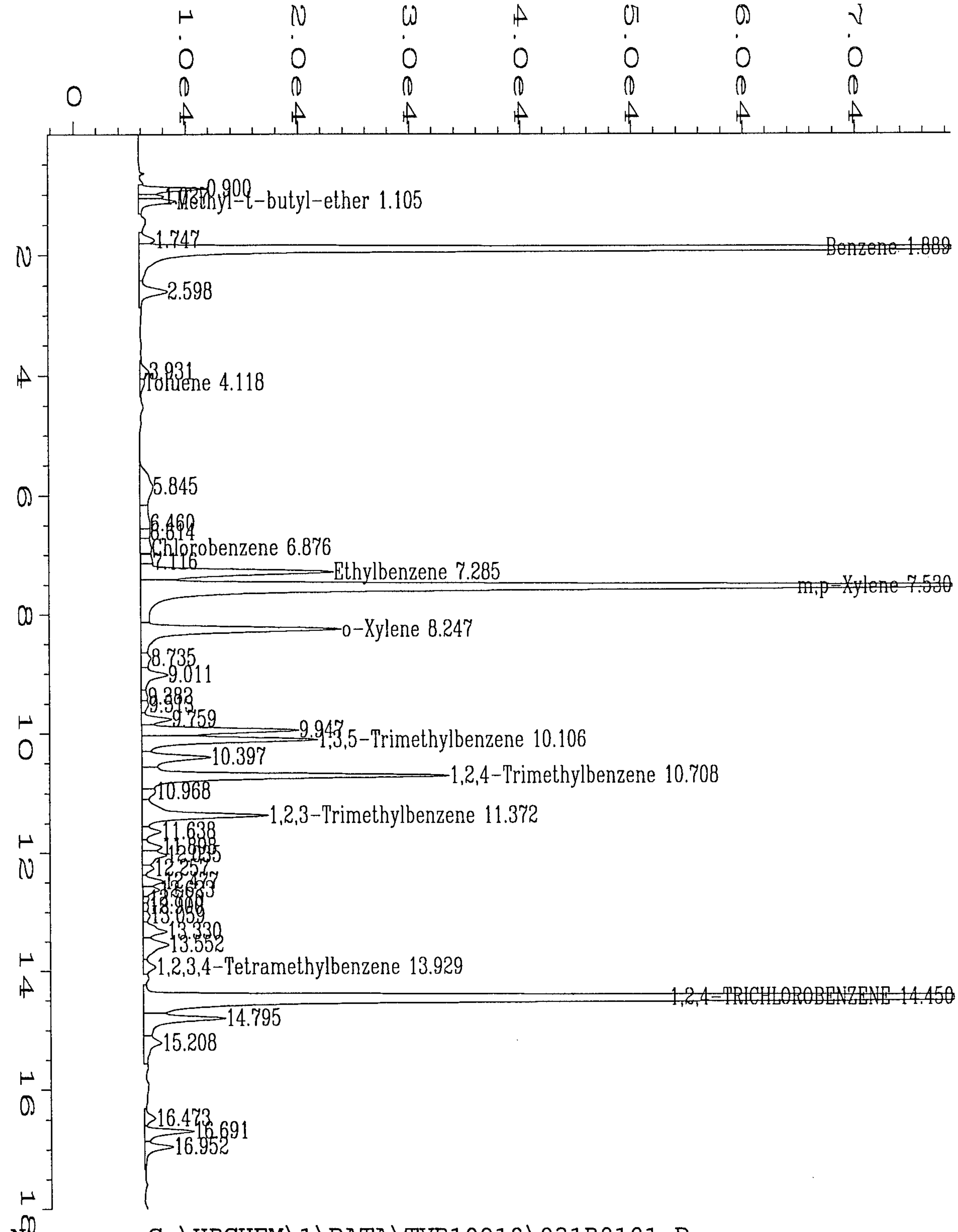
Sample Duplicate

Sample ID: **97-3397-01BDUP** Batch ID: **TVHBTEX1_9** Test Code: **SW8020a** Units: **µg/L** Run ID: **TVHBTEX1_970910A** Prep Date: **9/10/97**

Client ID: Matrix: **Water** Seq No: **12073** Analysis Date: **9/10/97 8:15:00 PM**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	5522	50	ND	ND	0.0%	0	0	5244	5.2%	30	
Toluene	ND	50	ND	ND	0.0%	0	0	ND	0.0%	30	
Ethylbenzene	1141	50	ND	ND	0.0%	0	0	1029	10.3%	30	
m,p-Xylene	4861	50	ND	ND	0.0%	0	0	4589	5.8%	30	
o-Xylene	1164	50	ND	ND	0.0%	0	0	1022	13.0%	30	
1,2,4-Trichlorobenzene	9760	0	12500	ND	78.1%	50	150	ND	0.0%	0	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
E - Analyte detected above calibration limits
B - Analyte detected in the associated Method Blank
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits



Data File Name	: C:\HPCHEM\1\DATA\TVB10910\021R0101.D		
Operator	: H. DIANE MILLS	Page Number	: 1
Instrument	: TVHBTEX1	Vial Number	: 21
Sample Name	: 97-3397-01BDUP	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 1
Acquired on	: 10 Sep 97 08:15 PM	Instrument Method:	TVH11216.MTH
Report Created on:	10 Sep 97 08:33 PM	Analysis Method	: BX10814A.MTH
Last Recalib on	: 14 AUG 97 02:36 PM	Sample Amount	: 0
Multiplier	: 1	ISTD Amount	:
Sample Info	: SAMP TVH_W BTEX_W		

EAKMW316-FP; 40 UL FUEL WEATHERING STUDY (AQUEOUS) DUP
DF=125

Evergreen
Analytical
Laboratory

OfFutt
Tank 349

July 17, 1997

CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY SUITE 900
DENVER, CO 80290

Work Order: 97-2372
Client Project: Parsons Fuel Study

Dear Craig Snyder:

Enclosed are the analytical results for the samples shown in the Work Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Carl Smits, Vice President of Quality Assurance.

SAMPLE DISPOSAL: Except for high level mercury (>260 ppm) samples, EAL will dispose of all samples one month from the date of this letter. If you want samples returned, please advise us by mail or fax as soon as possible.

RECORDS RETENTION: Effective January 1, 1996 we will retain a copy of this project report and supporting data for a period of three years. It has been our experience that a three year retention period is more than adequate to respond to client inquiries. If you want the project file sent to you after the three year period, please return a copy of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Jack Barney /cws

Jack Barney
President

Evergreen Analytical, Inc. 4036 Youngfield St. Wheat Ridge, CO 80033-3862 (303) 425-6021 FAX (303) 425-6854

Evergreen Analytical, Inc. 97-2372

WORK ORDER Summary

02-Jul 12:34 pm

Report To: Craig Snyder
Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Client Project ID: Parsons Fuel Study

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments:

QC Level: Laboratory Standard QC

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
97-2372-02A	MW349-6FP	BTEX		Organic	10		02-Jul-97	17-Jul-97	
97-2372-01A	OFMW349-6	Hold sample until further instructio			2	23-Jun-97	24-Jun-97	09-Jul-97	30-Jun-97

(SAMPLE HAD OPENED IN TRANSIT)

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY PARSONS ENGR. SCIENCE
ADDRESS 1700 BROADWAY, STE 900
CITY DENVER STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D. Fuel Weathering Study
EAL. QUOTE # ______ P.O.# 729691.35730
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day)
☐ Other (Specify) ______
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder
Evergreen Analytical Cooler No. NA
Cooler Received ______

Please **PRINT** all information:

EAL use only
Do not write in shaded area

WO# 97-2372 BOF# N/A BY JD
C/S(o) N/A N/A C/S(I) N/A / HD
Temp°C 21 Seals Intact Y/N/NA
Pres Y/N/NA Hd Sp Y/N/NA
Loc 2 Cont 40J

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: ~~Oil / Sludge~~ Gasoline	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)							EAL Sample No.
OFMW349-6	6/23/97	2010	1			X								X												-01A
HT:																										Location
DD:																										Container Size

Instructions: Analyze IAW Feb 28, 1997 letter from Parsons ES to Patty McClellan - Organic & Aqueous Phases
* Please Return to the above following analyses - Thank You!

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	6/24/97 1120	[signature]	6/24/97 11:20				

Offutt AFB
Tank 349

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW349-6FP	Client Project No.	: Parsons Fuel Study
Lab Sample Number	: 97-2372-02	Lab Work Order	: 97-2372
Date Sampled	: 6/23/97	Matrix	: Fuel Portion*
Date Received	: 7/2/97	Lab File Number(s)	: TVB10716031
Date Prepared	: 7/16/97	Method Blank	: FWS071697
FID Dilution Factor	: 2,500,000		
PID Dilution Factor	: 2,500,000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	7/17/97	14,000,000	10,000,000	ug/L
Toluene	108-88-3	7/17/97	52,000,000	10,000,000	ug/L
Ethyl Benzene	100-41-4	7/17/97	12,000,000	10,000,000	ug/L
Total Xylenes (m,p,o)	1330-20-7	7/17/97	57,000,000	10,000,000	ug/L
FID Surrogate Recovery:	NA			50%-150%	(Limits)
PID Surrogate Recovery:		112%		50%-150%	(Limits)

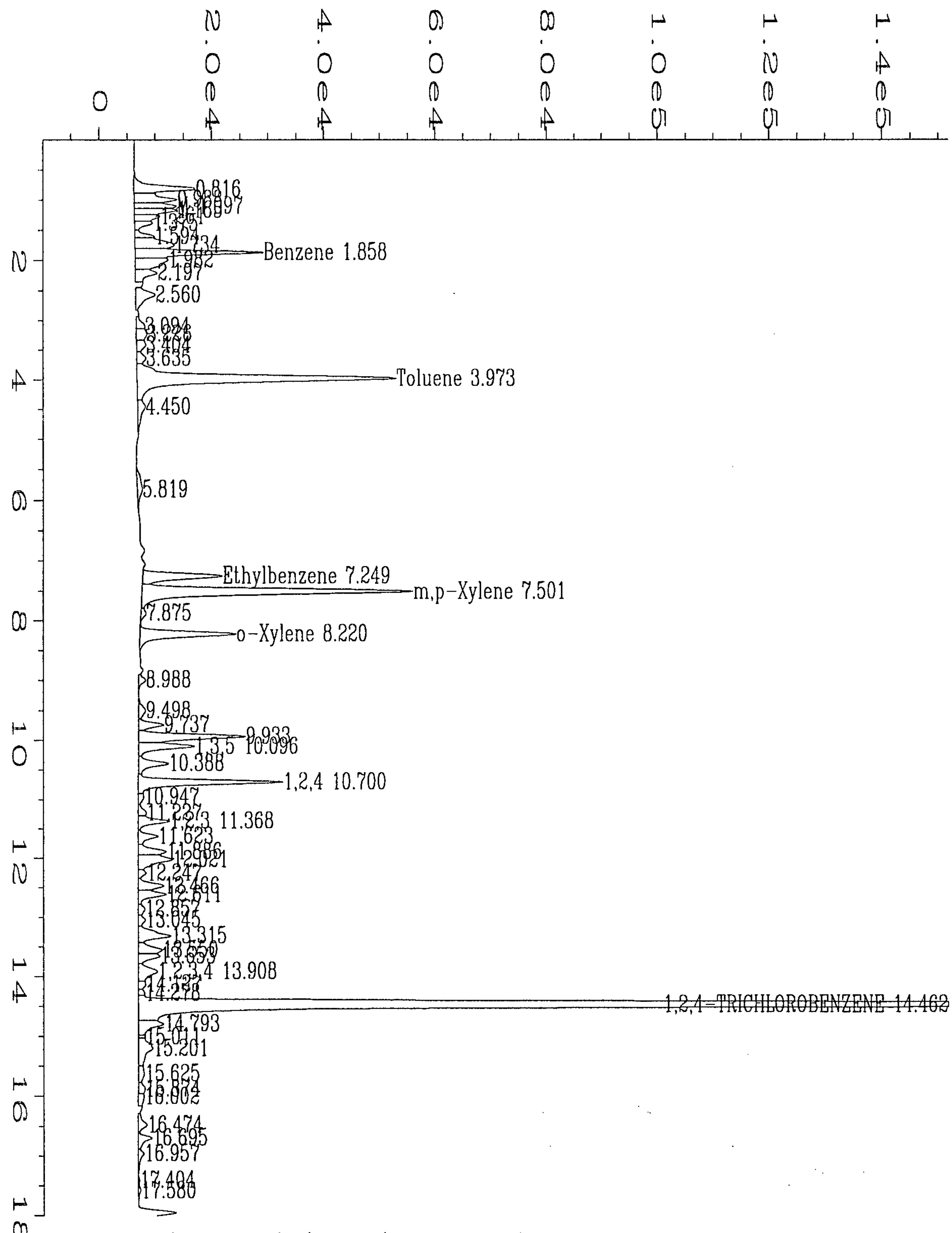
Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10716\031R0101.D
Operator : H.D. MILLS
Instrument : TVHBTEX1
Sample Name : 97-2372-02A1 FUEL PORTION
Run Time Bar Code:
Acquired on : 17 Jul 97 12:15 PM
Report Created on: 17 Jul 97 02:06 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 2.5e+006
Sample Info : SAMP BTEX_O
: :MW346-6FP; 20.0 UL OF 10 UL FUEL/1.000 ML MEOH OF 10 UL FUEL/1.000 ML MEOH. FUEL WEATHERING STUDY (FUEL)

Page Number : 1
Vial Number : 31
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

Offutt AFB
Tank 349

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: MW349-6FP	Client Project No.	:	Parsons Fuel Study
Lab Sample Number	: 97-2372-02	Lab Work Order	:	97-2372
Date Sampled	: 6/23/97	Matrix	:	Aqueous Portion*
Date Received	: 7/2/97	Lab File Number(s)	:	TVB10716024,033
Date Prepared	: 7/16/97	Method Blank	:	FWS071697
FID Dilution Factor	: 2500			
PID Dilution Factor	: 2500; 500			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	7/17/97	50,000	1000	ug/L
Toluene	108-88-3	7/17/97	66,000	1000	ug/L
Ethyl Benzene	100-41-4	7/16/97	10,000	200	ug/L
Total Xylenes (m,p,o)	1330-20-7	7/16/97	45,000	200	ug/L
FID Surrogate Recovery:		NA		50%-150%	(Limits)
PID Surrogate Recovery:		109%;107%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

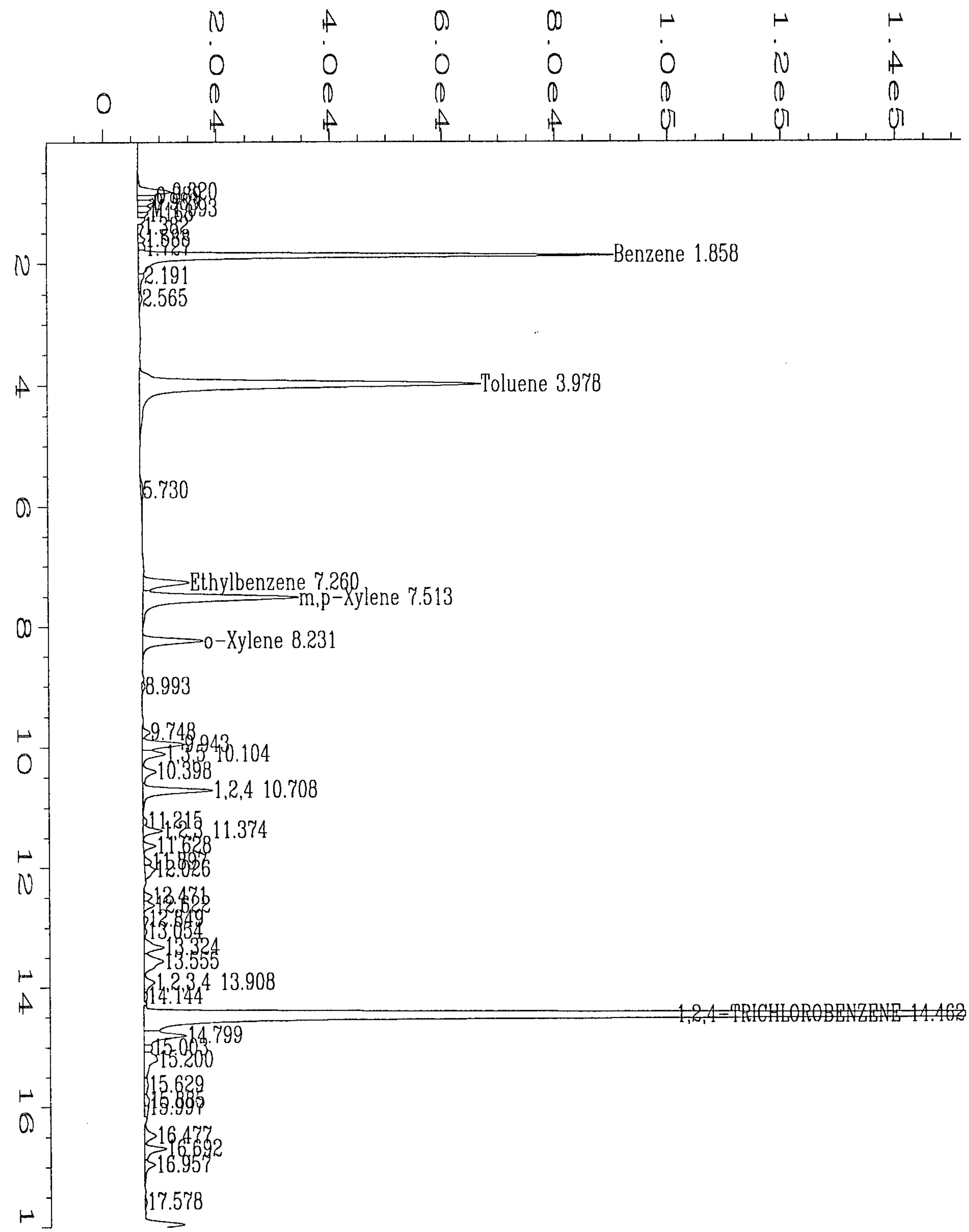
Comments: * = of Fuel Weathering Study.

QUALIFIERS and DEFINITIONS:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved

TVBXWS1;TVBX2372.XLS; 7/17/97; 2

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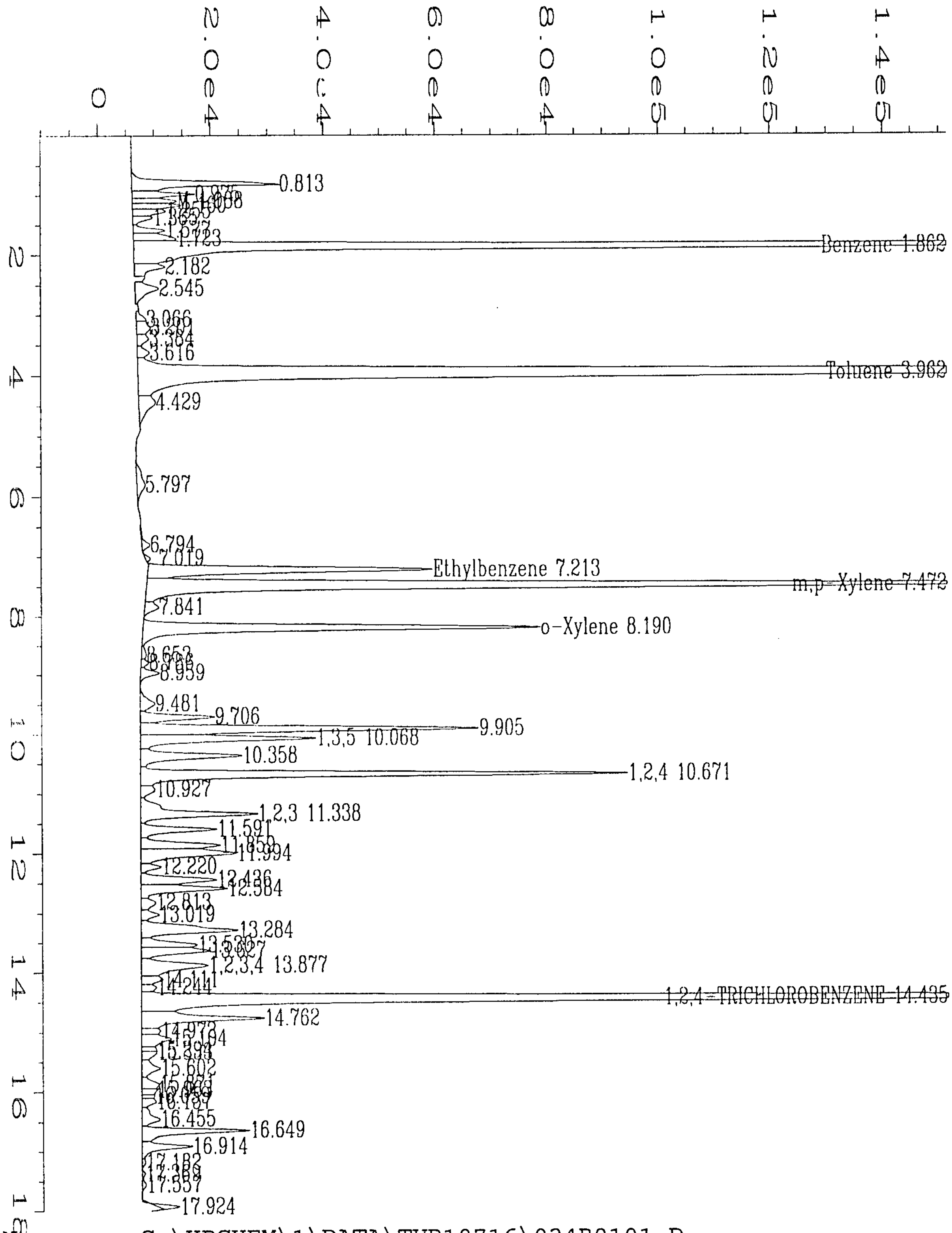
Data File Name    : C:\HPCHEM\1\DATA\TVB10716\033R0101.D
Operator          : H.D. MILLS                  Page Number        : 1
Instrument        : TVHBTEX1                    Vial Number        : 33
Sample Name       : 97-2372-02A1  WATER PORTION Injection Number   : 1
Run Time Bar Code:                              Sequence Line      : 1
Acquired on       : 17 Jul 97   01:18 PM        Instrument Method: TVH11216.MTH
Report Created on: 17 Jul 97   01:37 PM         Analysis Method    : BX10331.MTH
Last Recalib on   : 01 APR 97 11:26 AM          Sample Amount      : 0
Multiplier        : 2500                        ISTD Amount        :
Sample Info       : SAMP BTEX_W
                    ::MW346-6FP; 2 UL WATER, FUEL WEATHERING STUDY (AQUEOUS)
```



Data File Name : C:\HPCHEM\1\DATA\TVB10716\024R0101.D
Operator : H.D. MILLS
Instrument : TVHBTEX1
Sample Name : 97-2372-02A1 WATER PORTION
Run Time Bar Code:
Acquired on : 16 Jul 97 09:59 PM
Report Created on: 16 Jul 97 10:18 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 500 DILUTION
Sample Info : SAMP BTEX_W
: :MW346-6FP; 10 UL WATER, FUEL WEATHERING STUDY (AQUEOUS)

Page Number : 1
Vial Number : 24
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

Offuh AFB
Tank 349

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report
Method Blank Report

Method Blank Number	:	FWS071697	Client Project No.	:	Parsons Fuel Study
Date Prepared	:	7/16/97	Lab Work Order	:	97-2372
Dilution Factor	:	1.0	Matrix	:	WATER
			Lab File Number	:	TVB10716030

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	86290-81-5	NA	NA	NA	NA
Benzene	71-43-2	7/17/97	U	0.4	ug/L
Toluene	108-88-3	7/17/97	U	0.4	ug/L
Ethyl Benzene	100-41-4	7/17/97	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	7/17/97	0.4	0.4	ug/L
FID Surrogate Recovery:		NA		78%-127%	(Limits)
PID Surrogate Recovery:		109%		76%-120%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

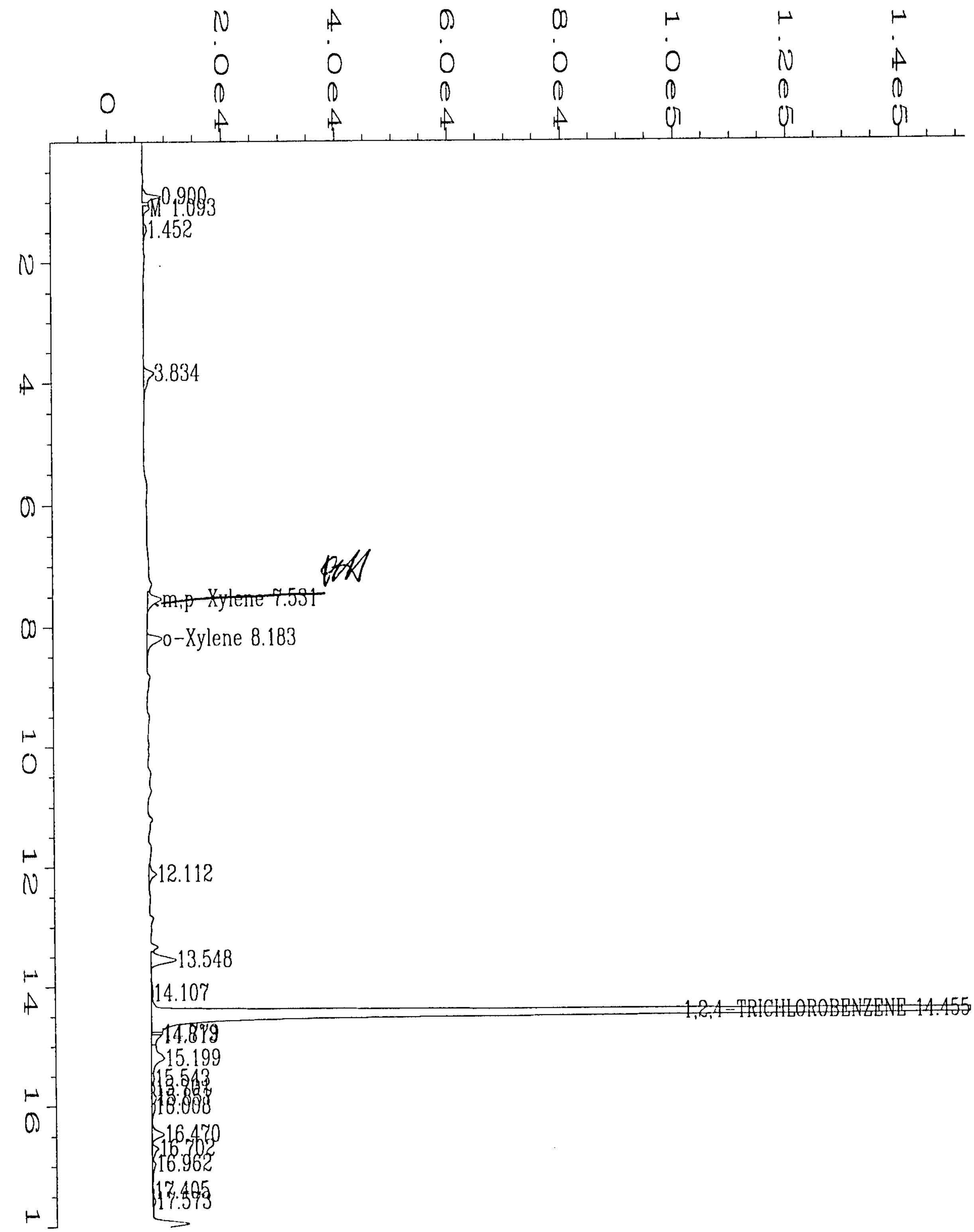
Comments: The amount of xylene in the blank is insignificant to the amount found in the samples.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved



Data File Name : C:\HPCHEM\1\DATA\TVB10716\030R0101.D
Operator : H.D. MILLS
Instrument : TVHBTEX1
Sample Name : FWS071~~7~~97 6
Run Time Bar Code:
Acquired on : 17 Jul 97 11:44 AM
Report Created on: 17 Jul 97 02:00 PM
Last Recalib on : 01 APR 97 11:26 AM
Multiplier : 1
Sample Info : MBLK BTEX_W
::FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 30
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH11216.MTH
Analysis Method : BX10331.MTH
Sample Amount : 0
ISTD Amount :

Evergreen
Analytical
Laboratory

March 19, 1998 Shaw 16 IC
Seymour Johnson 45.22 } 1998

CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY SUITE 900
DENVER, CO 80290

Lab Work Order: 98-0949
Client Project: Fuel Weathering Study

Dear Craig Snyder:

Enclosed are the analytical results for the samples shown in the Laboratory Work Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact Mark Mensik, Quality Assurance manager.

SAMPLE DISPOSAL: Except for high level mercury (>260 ppm) samples, EAL will dispose of all samples one month from the date of this letter. If you want samples returned, please advise us by mail or fax as soon as possible.

RECORDS RETENTION: Effective January 1, 1996 we will retain a copy of this project report and supporting data for a period of five years. It has been our experience that a five year retention period is more than adequate to respond to client inquiries. If you want the project file sent to you after the five year period, please return a copy of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

for Carl Smits
V.P. Operations

Evergreen Analytical Laboratory

98-0949

WORK ORDER Summary

12-Mar 11:55 am

Client Project ID: Fuel Weathering Study

Report To: Craig Snyder
Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments:

QC Level: Laboratory Standard QC

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
98-0949-01A	SJ98 MW1S-O	BTEX		Organic	2	10-Mar-98	12-Mar-98	26-Mar-98	24-Mar-98
98-0949-01B	SJ98 MW1S-W	BTEX		Water				26-Mar-98	17-Mar-98
98-0949-02A	SH98 1610-2-O	BTEX		Organic		11-Mar-98		26-Mar-98	25-Mar-98
98-0949-02B	SH98 1610-2-W	BTEX		Water				26-Mar-98	18-Mar-98

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

CMO

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY Parsons ES
ADDRESS 1700 Broadway, Suite 900
CITY Denver STATE CO ZIP 80290
PHONE# 303-831-8100 FAX # 303-831-8208 FAX RESULTS Y / N

CLIENT CONTACT (print) Craig Snyder
PROJECT I.D. Fuel Weathering Study
EAL. QUOTE # ____ P.O.# 729691.35730
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ STD UST (3 day) ☐ Other (Specify) ____
*expedited turnaround subject to additional fee

Sampler Name:
(signature) Craig B. Snyder
(print) Craig B. Snyder
Evergreen Analytical Cooler No. ____
Cooler Received ____

Free Product Seymour Johnson & Shaw AFB's

Please **PRINT** all information:

EAL use only
Do not write in shaded area

WO# 98-0949 BOF# n/a BY JD
C/S(O) N/A / N/A C/S(I) N/A / Co
Temp°C 13 Seals Intact Y / N / NA
Pres Y / N / NA Hd Sp Y / N / NA
Loc 2 Cont 20V

CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid	MATRIX: ~~Oil / Sludge~~ Jet Fuel	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	Herbicides 8150/515 (circle)	PCB Screen	BTEX 8020/602 (circle)/MTBE (circle)	TRPH 418.1/Oil & Grease 413.1 (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	EAL Sample No.
SJ98 MW1S	3/10/98		1											X						-01
SH98 1610-2	3/11/98		1											X						-02
HT:														A						Location 2
DD:														20V						Container Size

Instructions: Analyze IAW Feb 28, 1997 letter from Parsons ES to Patty McClellan - Organic & Aqueous Phases

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Craig B. Snyder	3/11/98 1700	Bonnie Mager	3/12/98 0930				

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : SJ98 MW1S-W
Lab Sample ID : 98-0949-01B
Date Collected : 03/10/98
Date Received : 03/12/98

Client Project ID : Fuel Weathering Study
Lab Work Order : 98-0949
Sample Matrix : Water

Method: E602/SW8020A **BTEX**

Date Prepared : 03/13/98
Date Analyzed : 03/13/98
Lab File ID : TVB10311\073R0101.D
Method Blank : FMB1031398
Effective Dilution : 25

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	180	10	μg/L
Toluene	108-88-3	790	10	μg/L
Ethylbenzene	100-41-4	310	10	μg/L
m,p-Xylene	1330-20-7	810	10	μg/L
o-Xylene	95-47-6	510	10	μg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	100%	65 - 141	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

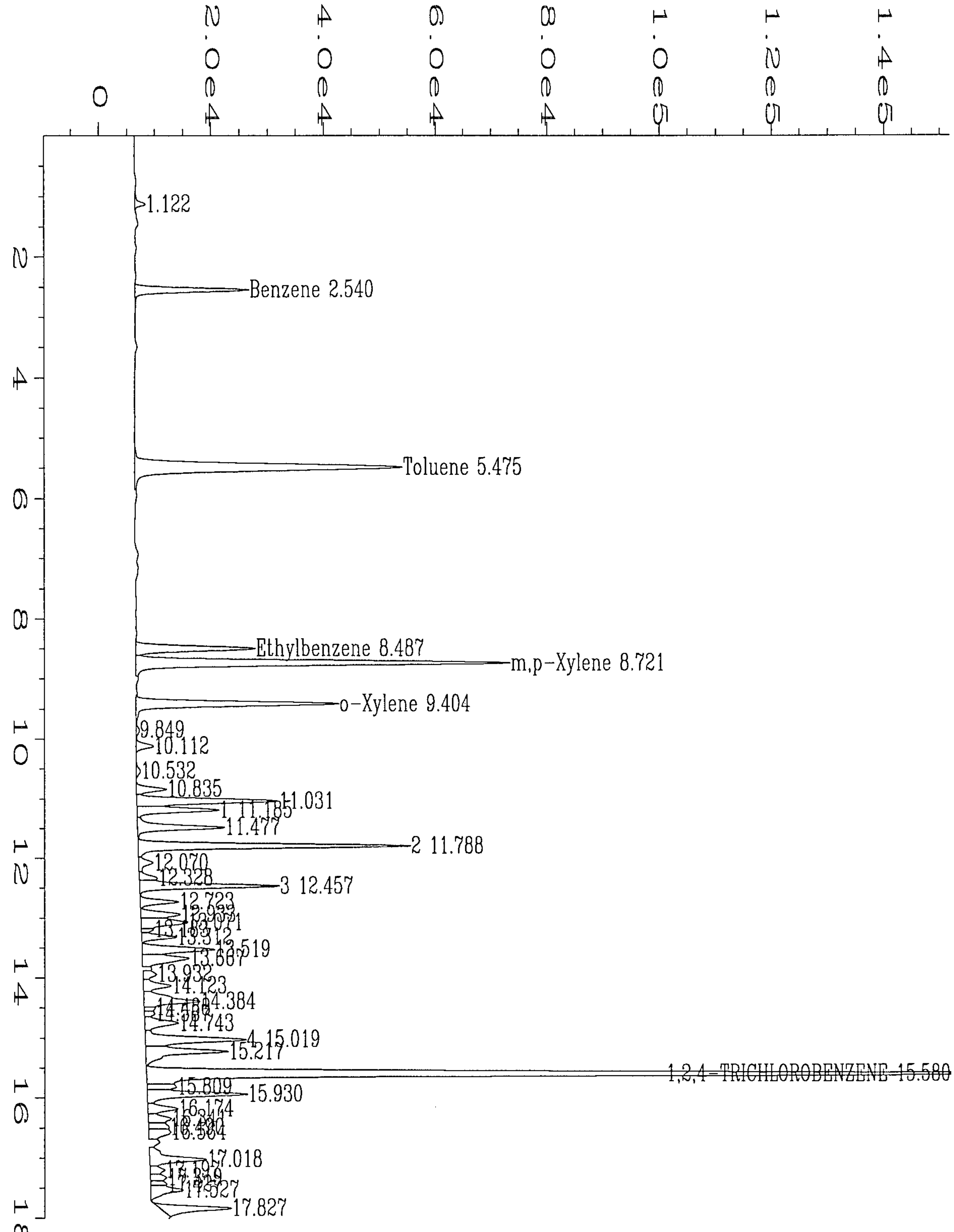
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

3/17/98 1:59:31 PM



ata File Name : C:\HPCHEM\1\DATA\TVB10311\073R0101.D
Operator : KAPRIE S. HOLLMAN
Instrument : TVHBTEX1
ample Name : 98-0949-01A-AQ
un Time Bar Code:
Acquired on : 13 Mar 98 02:57 PM
eport Created on: 13 Mar 98 03:16 PM
ast Recalib on : 11 MAR 98 03:08 PM
Multiplier : 1
Sample Info : SAMP TVH_W BTEX_W
SJ98MW1S; 200 ul AQUEOUS PORTION; FUEL WEATHERING STUDY
DF=25

Page Number : 1
Vial Number : 73
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10311B.MTH
Sample Amount : 0
ISTD Amount :

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : SJ98 MW1S-O
Lab Sample ID : 98-0949-01A
Date Collected : 03/10/98
Date Received : 03/12/98

Client Project ID : Fuel Weathering Study
Lab Work Order : 98-0949
Sample Matrix : Organic

Method: E602/SW8020A **BTEX**

Date Prepared : 03/13/98
Date Analyzed : 03/13/98
Lab File ID : TVB10311\077R0101.D
Method Blank : FMB1031398
Effective Dilution : 100000

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	50000 J	400000	µg/L
Toluene	108-88-3	630000	400000	µg/L
Ethylbenzene	100-41-4	1100000	400000	µg/L
m,p-Xylene	1330-20-7	3100000	400000	µg/L
o-Xylene	95-47-6	1400000	400000	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	154%	45 - 161	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

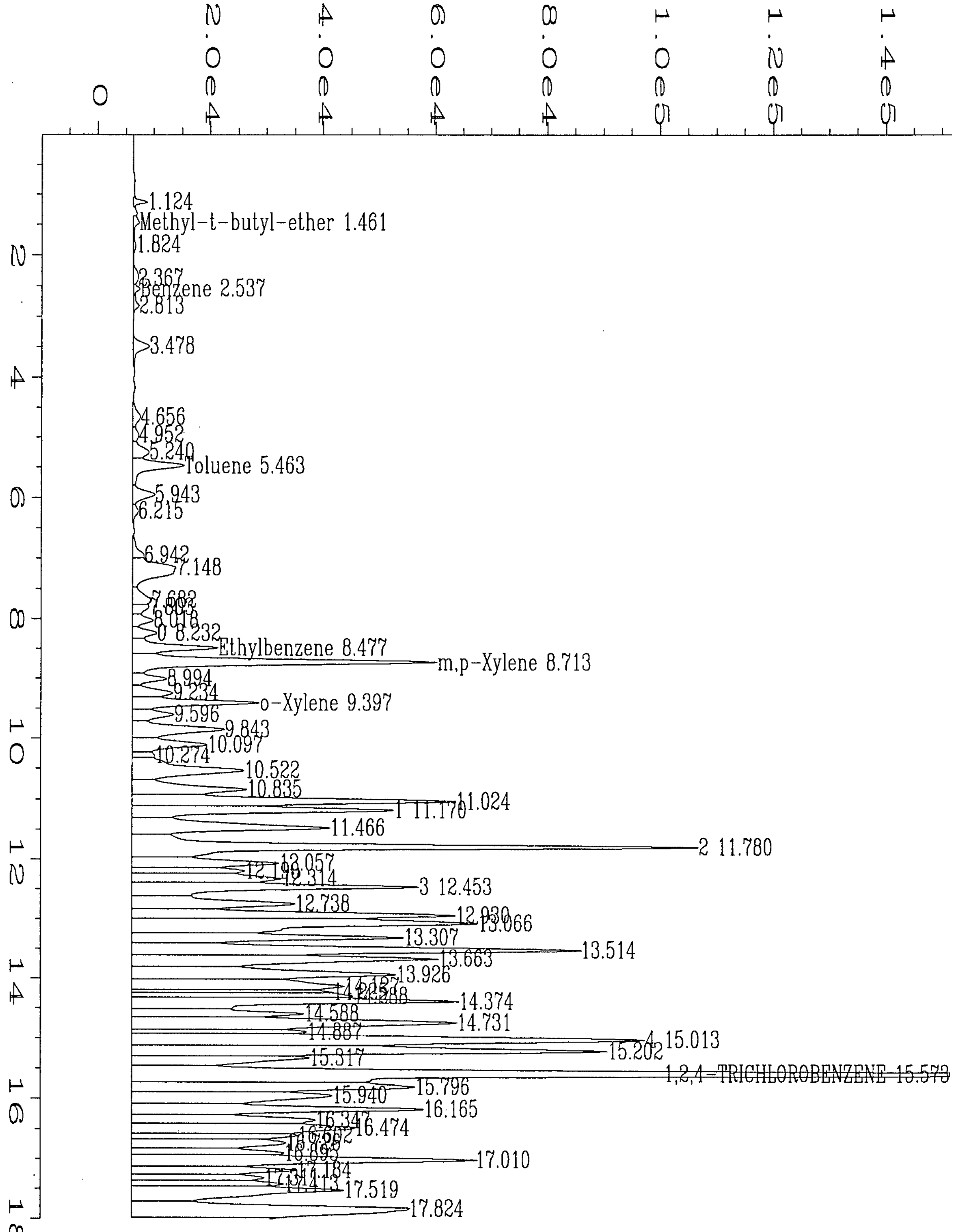
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst **Approved**

3/23/98 2:55:16 PM



Data File Name : C:\HPCHEM\1\DATA\TVB10311\077R0101.D
Operator : KAPRIE S. HOLLMAN
Instrument : TVHBTEX1
Sample Name : 98-0949-01B-F
Run Time Bar Code:
Acquired on : 13 Mar 98 05:06 PM
Report Created on: 16 Mar 98 07:44 AM
Last Recalib on : 11 MAR 98 03:08 PM
Multiplier : 1
Sample Info : SAMP TVH_O BTEX_O
SJ98MW1S; 5 ul 1/100 DIL. FUEL PORTION; FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 77
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10311B.MTH
Sample Amount : 0
ISTD Amount :

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : SH98 1610-2-O
Lab Sample ID : 98-0949-02A
Date Collected : 03/11/98
Date Received : 03/12/98

Client Project ID : Fuel Weathering Study
Lab Work Order : 98-0949
Sample Matrix : Organic

Method: E602/SW8020A **BTEX**

Date Prepared : 03/13/98
Date Analyzed : 03/13/98
Lab File ID : TVB10311\078R0101.D
Method Blank : FMB1031398
Effective Dilution : 100000

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	1300000	400000	µg/L
Toluene	108-88-3	3000000	400000	µg/L
Ethylbenzene	100-41-4	1400000	400000	µg/L
m,p-Xylene	1330-20-7	5900000	400000	µg/L
o-Xylene	95-47-6	3100000	400000	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	148%	45 - 161	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

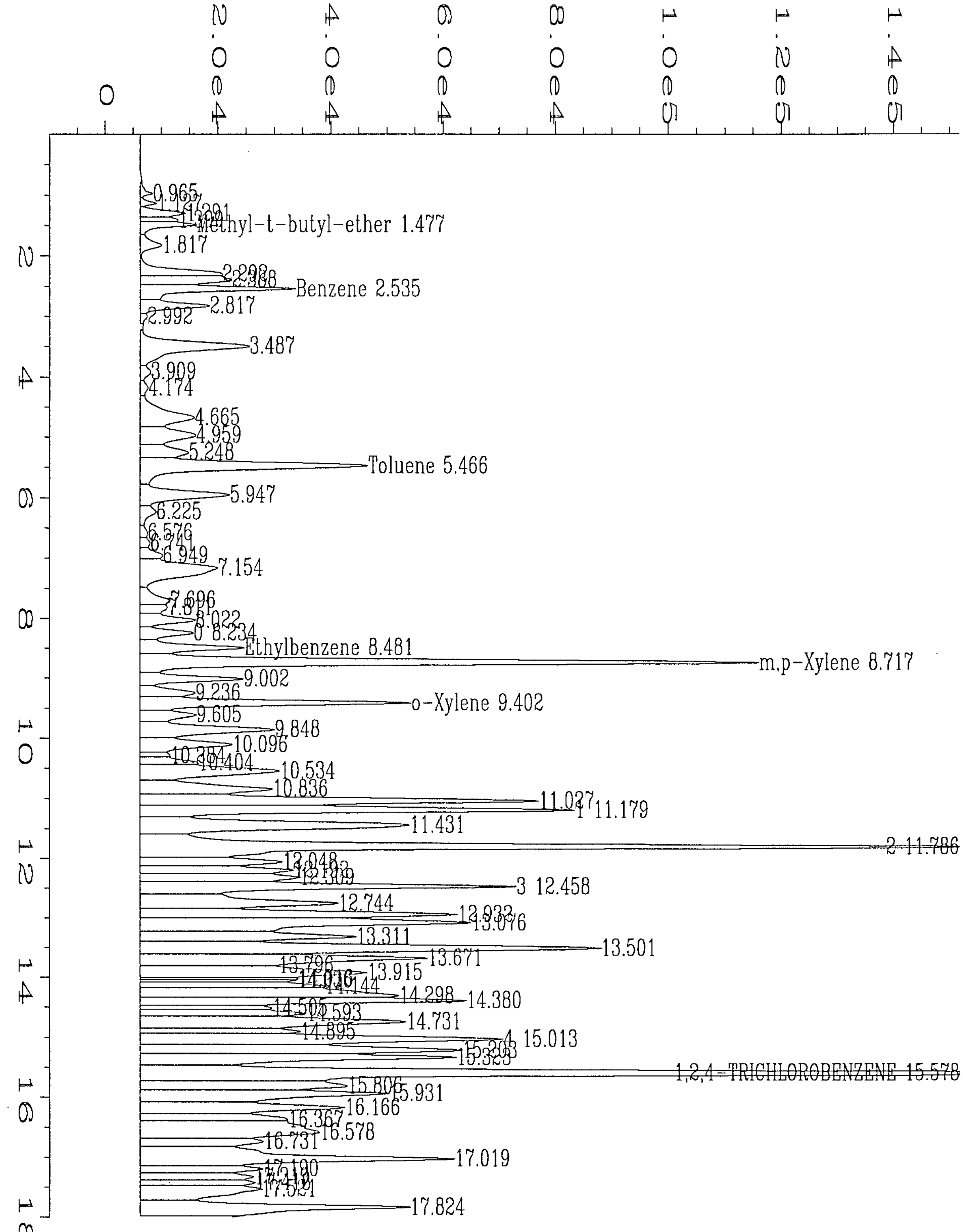
Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst **Approved** 3/23/98 2:55:16 PM



Data File Name : C:\HPCHEM\1\DATA\TVB10311\078R0101.D
Operator : KAPRIE S. HOLLMAN
Instrument : TVHBTEX1
Sample Name : 98-0949-02B-F
Run Time Bar Code:
Acquired on : 13 Mar 98 05:39 PM
Report Created on: 16 Mar 98 07:46 AM
Last Recalib on : 11 MAR 98 03:08 PM
Multiplier : 1
Sample Info : SAMP TVH_O BTEX_O
SH981610-2; 5.0 ul 1/100 DIL. FUEL PORTION; FUEL WEATHERING STUDY

Page Number : 1
Vial Number : 78
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10311B.MTH
Sample Amount : 0
ISTD Amount :

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : SH98 1610-2-W
Lab Sample ID : 98-0949-02B
Date Collected : 03/11/98
Date Received : 03/12/98

Client Project ID : Fuel Weathering Study
Lab Work Order : 98-0949
Sample Matrix : Water

Method: E602/SW8020A **BTEX**

Date Prepared : 03/13/98 **Lab File ID** : TVB10311\074R0101.D **Effective Dilution** : 25
Date Analyzed : 03/13/98 **Method Blank** : FMB1031398

Compound Name	CAS Number	Concentration	RL	Units
Ethylbenzene	100-41-4	410	10	µg/L
m,p-Xylene	1330-20-7	1900	10	µg/L
o-Xylene	95-47-6	1200	10	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	107%	65 - 141	QC Limits

Comments:

Date Prepared : 03/16/98 **Lab File ID** : TVB10316\037R0101.D **Effective Dilution** : 250
Date Analyzed : 03/17/98 **Method Blank** : FMB1031398

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	6000	100	µg/L
Toluene	108-88-3	3800	100	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	104%	65 - 141	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

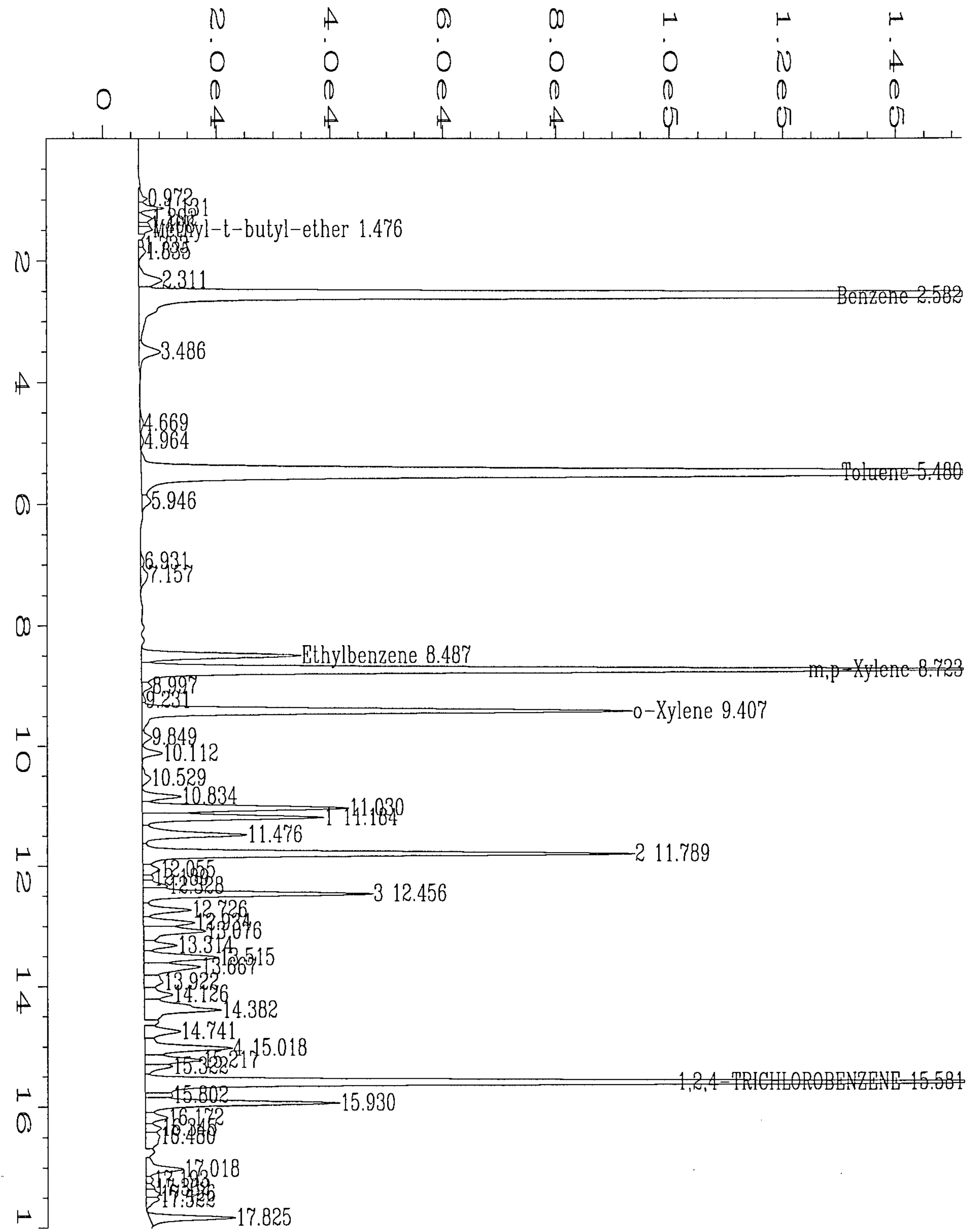
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

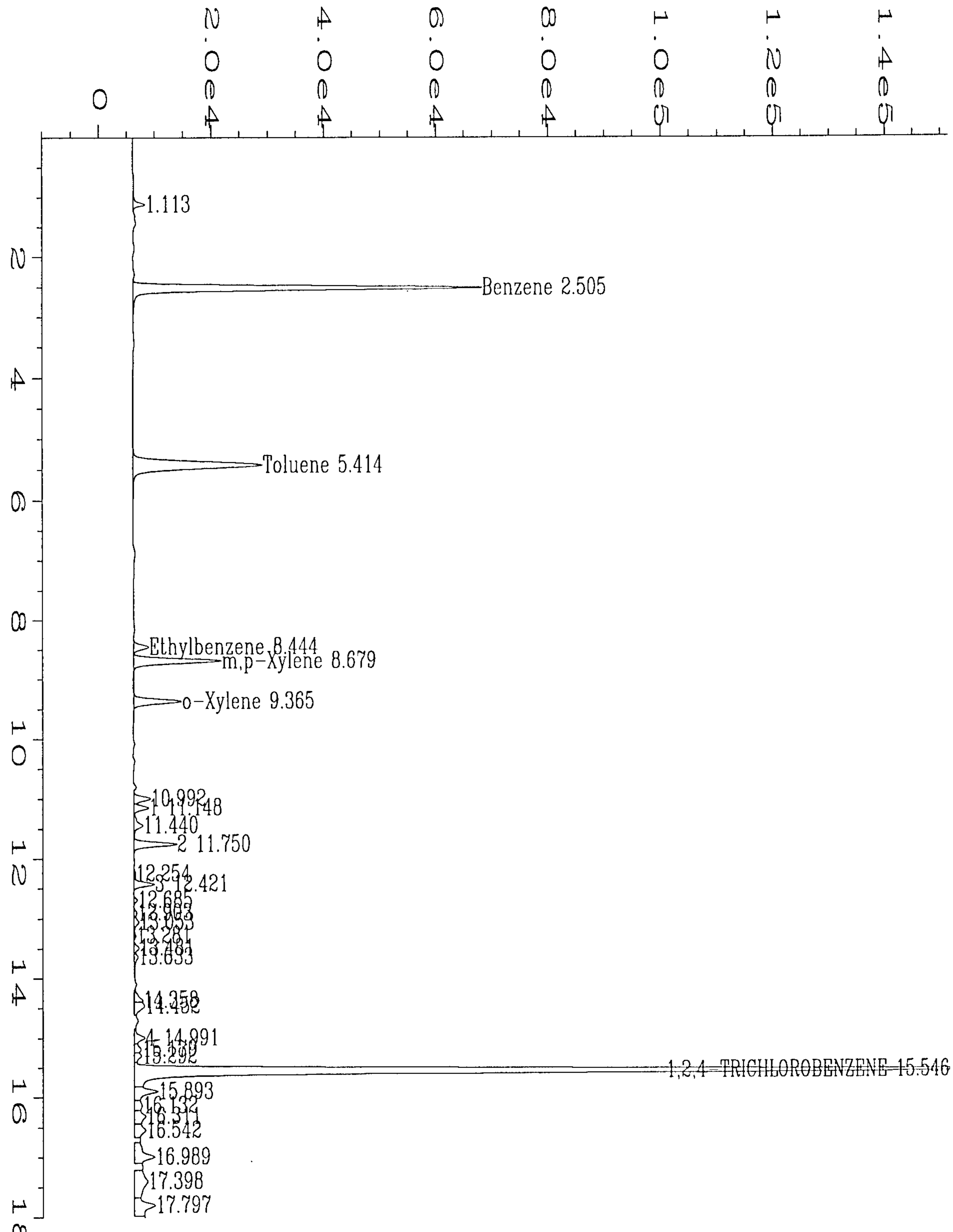
[signature]
Analyst

Approved

3/17/98 2:17:54 PM



Data File Name : C:\HPCHEM\1\DATA\TVB10311\074R0101.D
Operator : KAPRIE S. HOLLMAN
Page Number : 1
Instrument : TVHBTEX1
Vial Number : 74
Sample Name : 98-0949-02A-AQ
Injection Number : 1
Run Time Bar Code:
Sequence Line : 1
Acquired on : 13 Mar 98 03:29 PM
Instrument Method: TVH10126.MTH
Report Created on: 13 Mar 98 03:48 PM
Analysis Method : BX10311B.MTH
Last Recalib on : 11 MAR 98 03:08 PM
Sample Amount : 0
Multiplier : 1
ISTD Amount :
Sample Info : SAMP TVH_W BTEX_W
SH981610-2; 200 ul AQUEOUS PORTION; FUEL WEATHERING STUDY
DF=25



Data File Name : C:\HPCHEM\1\DATA\TVB10316\037R0101.D
Operator : H. DIANE MILLS
Instrument : TVHBTEX1
Sample Name : 98-0949-02A-AQ
Run Time Bar Code:
Acquired on : 17 Mar 98 09:37 AM
Report Created on: 17 Mar 98 09:55 AM
Last Recalib on : 11 MAR 98 03:08 PM
Multiplier : 1
Sample Info : SAMP TVH_W BTEX_W
SH981610-2; 20 ul AQUEOUS PORTION; FUEL WEATHERING STUDY
DF=250

Page Number : 1
Vial Number : 37
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10311B.MTH
Sample Amount : 0
ISTD Amount :

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Method Blank Data Report

Lab Work Order : 98-0949 **Client Project ID :** Fuel Weathering Study
Lab Sample ID : FMB1031398

Method: E602/SW8020A **BTEX**

Date Prepared : 03/13/98 **Lab File ID** : TVB10311\072R0101.D **Effective Dilution** : 1
Date Analyzed : 03/13/98

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	104%	65 - 141	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

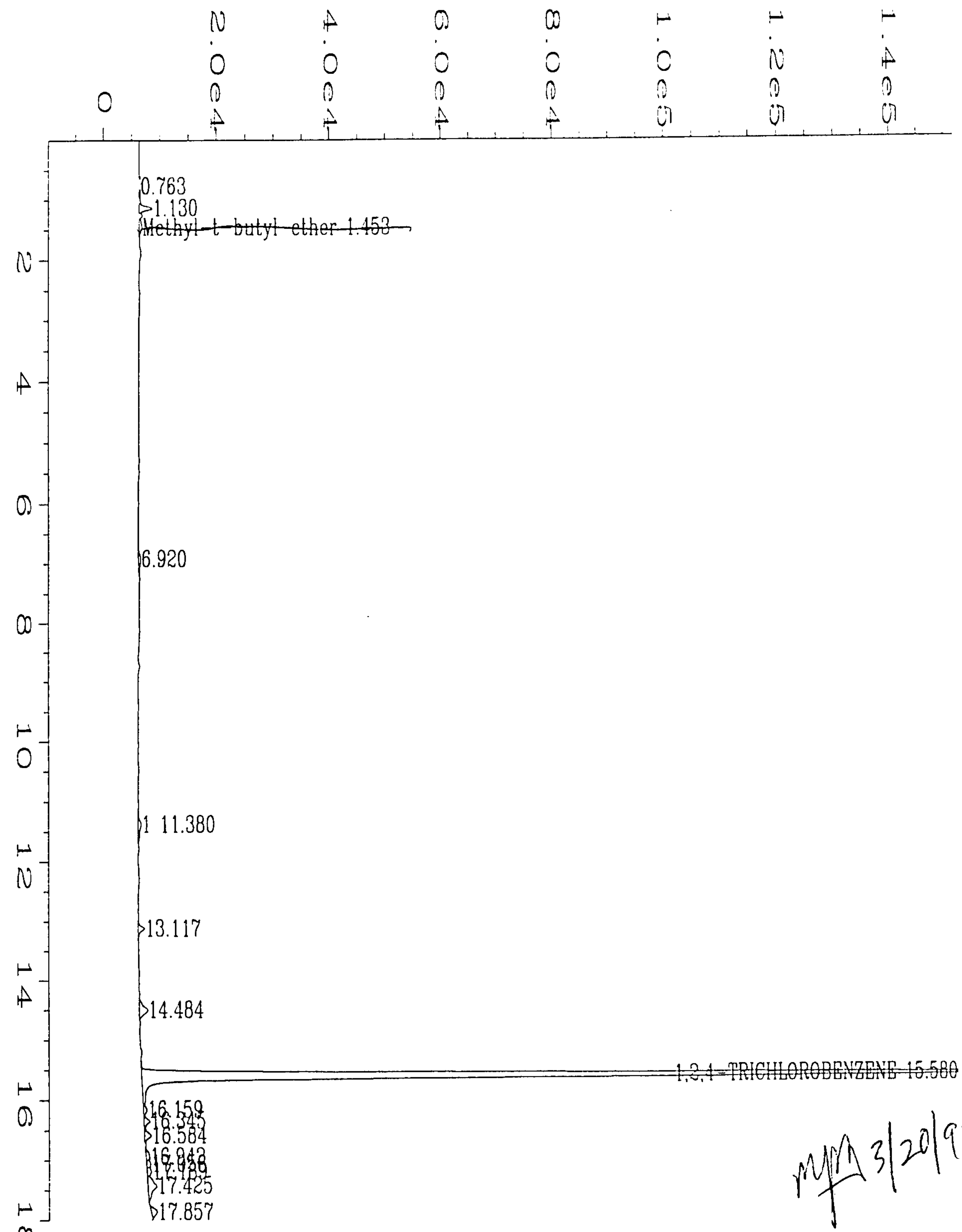
Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst **Approved** *3/17/98 1:59:34 PM*



[illegible] 3/20/98

Data File Name : C:\HPCHEM\1\DATA\TVB10311\072R0101.D
Operator : KAPRIE S. HOLLMAN
Instrument : TVHBTEX1
Sample Name : FMB1031398
Run Time Bar Code:
Acquired on : 13 Mar 98 02:24 PM
Report Created on: 13 Mar 98 02:43 PM
Last Recalib on : 11 MAR 98 03:08 PM
Multiplier : 1
Sample Info : MBLK TVH_W BTEX_W
FUEL EXTRACTION METHOD BLANK
DF=1

Page Number : 1
Vial Number : 72
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10311B.MTH
Sample Amount : 0
ISTD Amount :

Evergreen
Analytical
Laboratory

November 13, 1998

CRAIG SNYDER
PARSONS ENGINEERING SCIENCE
1700 BROADWAY SUITE 900
DENVER, CO 80290

Lab Work Order: 98-4878
Client Project: OFFUTT AFB, NEBRASKA

Dear Craig Snyder:

Enclosed are the analytical results for the samples shown in the Laboratory Work Order Summary. The enclosed data have been reviewed for quality assurance. If you have any questions concerning the reported information, please contact me.

Yes	No	NA*	
X			The samples received in good condition within EPA holding times.
X			Custody seals present. Seal intact: X Yes ___No
		X	Samples preserved to acceptable pH levels.
X			Samples analyzed within holding times per the analytical method.
	X		A case narrative explaining analytical anomalies is attached.

NA*=not applicable

The temperature of the sample(s) upon arrival was 20 degrees C.

This report contains a total of 9 pages including the cover letter.

SAMPLE DISPOSAL: Except for high level mercury (>260 ppm) samples, EAL will dispose of all samples one month from the date of this letter. If you want samples returned, please advise us by mail or fax as soon as possible.

RECORDS RETENTION: A copy of this project report and supporting data will be retained for a period of five years. If you want the project file sent to you after the five year period, please return a copy of this letter.

The invoice for this work will be mailed to your Accounts Payable department shortly.

Thank you for using the services of Evergreen Analytical.

Sincerely,

Carl Smits

Carl Smits
V.P. Operations

Evergreen Analytical Laboratory

98-4878

WORK ORDER Summary

30-Oct 10:06 am

Client Project ID: OFFUTT AFB, NEBRASKA

Report To: Craig Snyder
Parsons Engineering Science
1700 Broadway Suite 900
Denver, CO 80290

Phone: (303) 831-8100
FAX: (303) 831-8208

Comments:

QC Level: **Laboratory Standard QC**

Sample ID	Client Sample ID	Analysis	#	Matrix	Loc	Collection	Received	Due	HT
98-4878-01A	OFMW349-6	BTEX		Organic	2	27-Oct-98	30-Oct-98	13-Nov-98	10-Nov-98

# = Special list. See sample comments or test information.
HT = Holding Time expiration date.

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Evergreen Analytical Inc.
4036 Youngfield St.
Wheat Ridge, Colorado 80033
(303) 425-6021
FAX (303) 425-6854
(800) 845-7400

COMPANY PARSONS ENGR. SCIENCE
ADDRESS 1700 BROADWAY, SUITE 900
CITY DENVER STATE CO ZIP 80290
PHONE# 303-831-8100 FAX# 303-831-8208
REPORT TO (Mr/Ms)
INVOICE TO
PROJECT I.D. OFFUTT AFB, NEBRASKA
P.O. # EAL. QUOTE #
Sampler Name:
(print) ADAM RUBACK
(signature) Adam R

Please **PRINT** all information:

Report Results by: ____ (Date)*
Standard 2 working weeks ☐
3 day UST Analyses per Fee Schedule ☐
* Rush: ☐ < 24 hrs ☐ 1 - 2 work days ☐ 3 - 5 work days ☐ 6 - 9 work days
*Rush analysis subject to additional fee

SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: ~~Oil / Sludge / Multiphase~~ GASOLINE	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen 8080 mod.	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	For Laboratory use only
OF MW349-6	10/27/98	12:30	2			X								X							-01
Sample Fraction																					Loc Z
Container																					

For Laboratory use only
W.O. # 98-4878
B.O.F. # N/A
C/S (O) N/A / N/A
C/S (I) C / CO
Cooler Temp. °C 20
Seals Intact Y / N / NA
Samples Pres. Y / N / NA
Headspace Y / N / NA
By JDI

Instructions:
REFERENCE LETTER, QUOTE #1486, FUEL WEATHERING, FEB 28th LETTER FROM PARSONS ES TO PATY McCLELLAN - ORGANIC & AQUEOUS PHASES

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
Adam R	10/27/98	J Dechus	10/30/98 10:00				

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OFMW349-6
Lab Sample ID : 98-4878-01A
Date Collected : 10/27/98
Date Received : 10/30/98

Client Project ID : OFFUTT AFB, NEBRASKA
Lab Work Order : 98-4878
Sample Matrix : Organic

Method: E602/SW8020A — **BTEX**

Date Prepared : 11/09/98
Date Analyzed : 11/10/98
Lab File ID : TVB11109\042R0101.D
Method Blank : FMB110998
Effective Dilution : 2500000

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	3300000	1000000	µg/L
Toluene	108-88-3	30000000	1000000	µg/L
Ethylbenzene	100-41-4	12000000	1000000	µg/L
m,p-Xylene	1330-20-7	37000000	1000000	µg/L
o-Xylene	95-47-6	17000000	1000000	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	92%	64 - 133	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak. Confirmation analysis was not performed.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

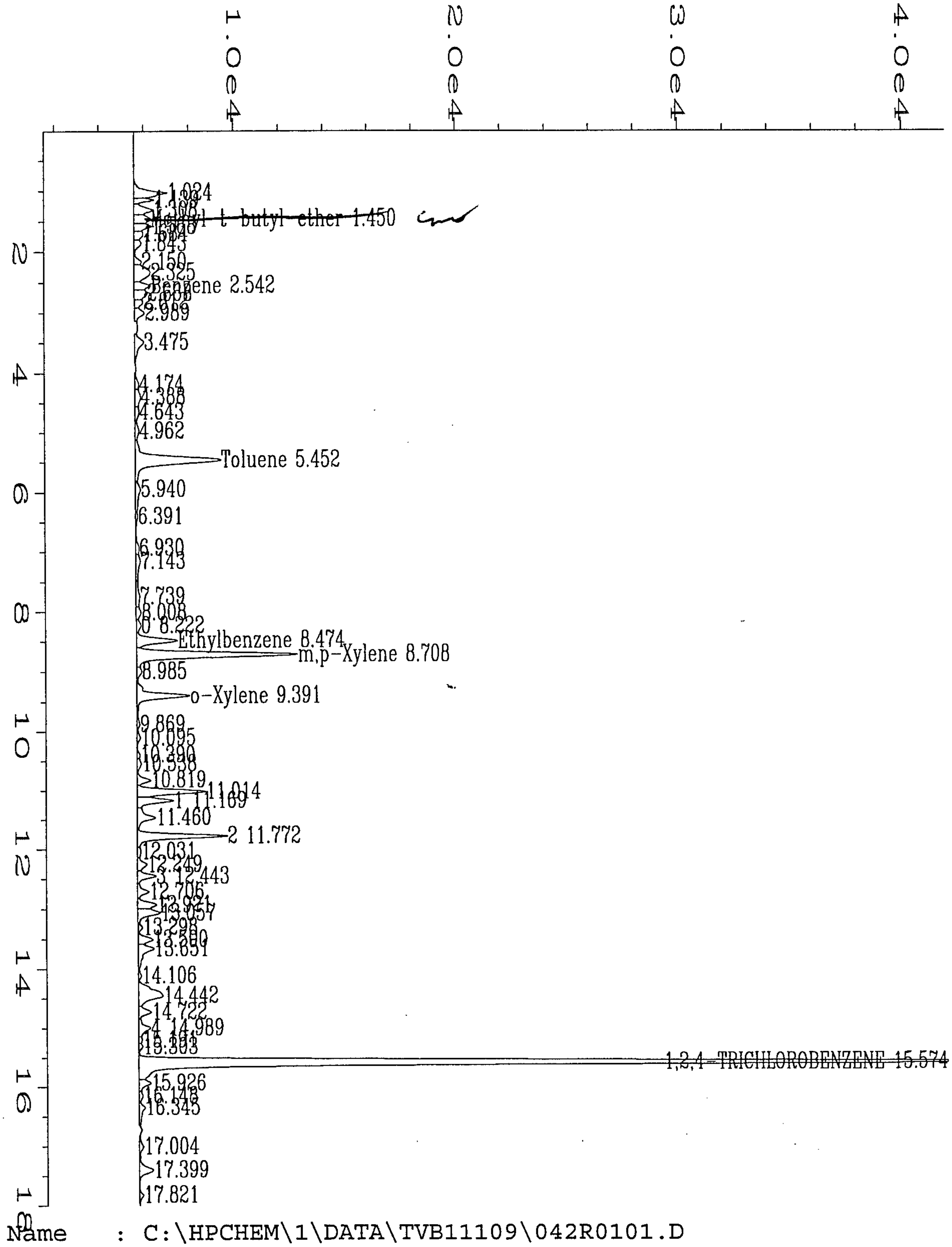
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

11/18/98 10:07:29 AM



Data File Name : C:\HPCHEM\1\DATA\TVB11109\042R0101.D
Operator : S. BINGHAM
Instrument : TVHBTEX1
Sample Name : 98-4878-01A
Run Time Bar Code:
Acquired on : 10 Nov 98 04:37 PM
Report Created on: 10 Nov 98 04:56 PM
Last Recalib on : 31 AUG 98 01:18 PM
Multiplier : 1
Sample Info : SAMP TVH_W BTEX_W
OFMW349-6;.01ML FUEL/10ML MeOH;.002ML EXT/5ML WATER
DF=2500000

Page Number : 1
Vial Number : 42
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10831.MTH
Sample Amount : 0
ISTD Amount :

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OFMW349-6
Lab Sample ID : 98-4878-01B
Date Collected : 10/27/98
Date Received : 10/30/98

Client Project ID : OFFUTT AFB, NEBRASKA
Lab Work Order : 98-4878
Sample Matrix : Water

Method: E602/SW8020A **BTEX**

Date Prepared : 11/09/98 **Lab File ID** : TVB11109\040R0101.D **Effective Dilution** : 2500
Date Analyzed : 11/10/98 **Method Blank** : FMB110998

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	8800	1000	µg/L
Toluene	108-88-3	20000	1000	µg/L
Ethylbenzene	100-41-4	1800	1000	µg/L
m,p-Xylene	1330-20-7	5500	1000	µg/L
o-Xylene	95-47-6	3500	1000	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	88%	65 - 141	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak. Confirmation analysis was not performed.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

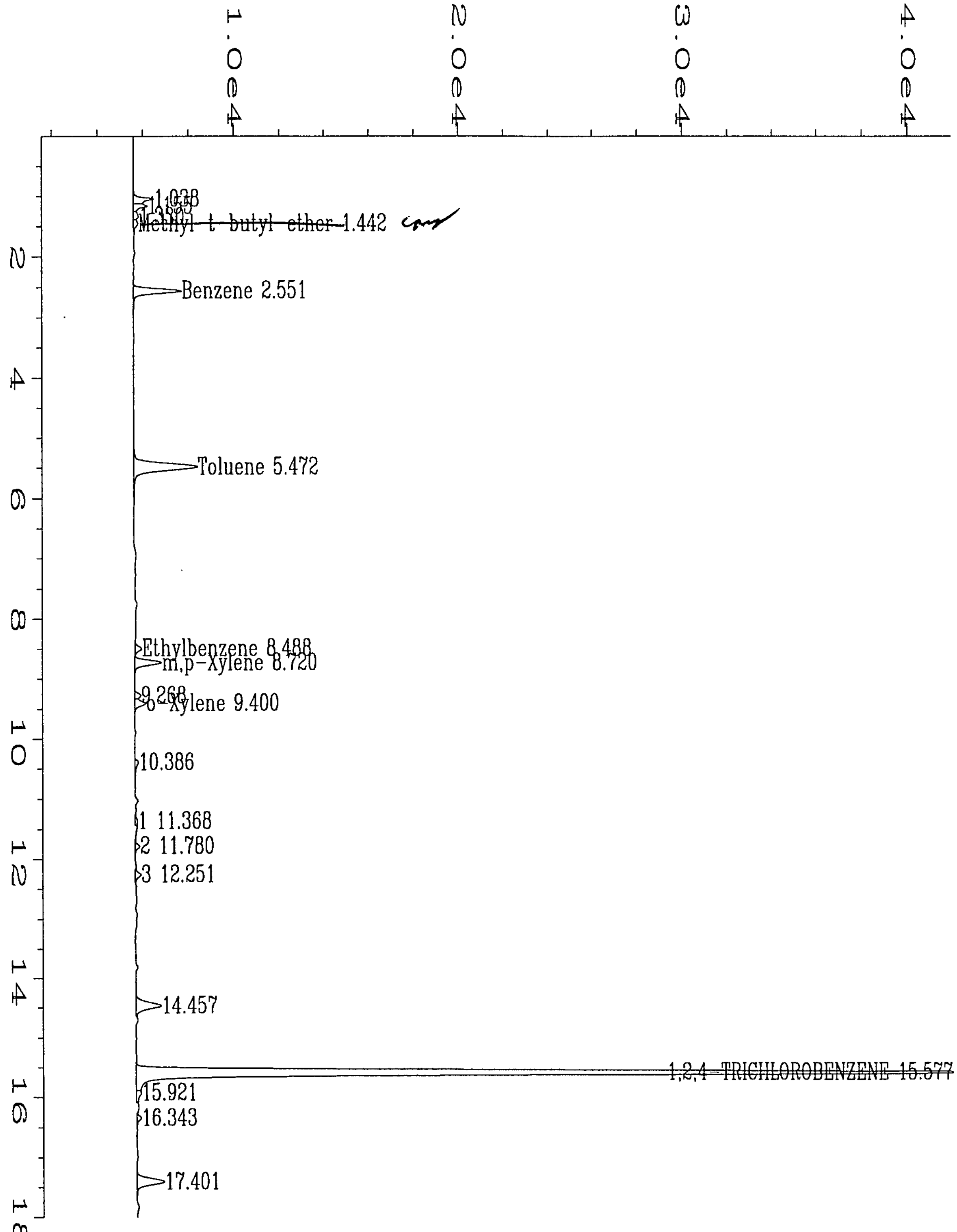
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

ScB
Analyst

Approved

11/11/98 2:20:08 PM

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perator          : S. BINGHAM                Page Number       : 1
Instrument       : TVHBTEX1                  Vial Number       : 40
ample Name       : 98-4878-01A               Injection Number  : 1
un Time Bar Code:                            Sequence Line     : 1
Acquired on      : 10 Nov 98   03:23 PM      Instrument Method: TVH10126.MTH
eport Created on: 10 Nov 98   03:43 PM       Analysis Method   : BX10831.MTH
ast Recalib on   : 31 AUG 98 01:18 PM        Sample Amount     : 0
Multiplier       : 1                         ISTD Amount       :
Sample Info      : SAMP TVH_W BTEX_W
                   OFMW349-6;.002ML AQUEOUS EXT/5ML WATER
                   DF=2500
```

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Method Blank Data Report

Lab Work Order : 98-4878
Lab Sample ID : FMB110998
Client Project ID : OFFUTT AFB, NEBRASKA

Method: E602/SW8020A **BTEX + MTBE**

Date Prepared : 11/09/98 **Lab File ID** : TVB11109\061R0101.D **Effective Dilution** : 1
Date Analyzed : 11/11/98

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
Surrogate Recovery:	1,2,4-Trichlorobenzene	91%	65 - 141	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.
Confirmation analysis was not performed.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

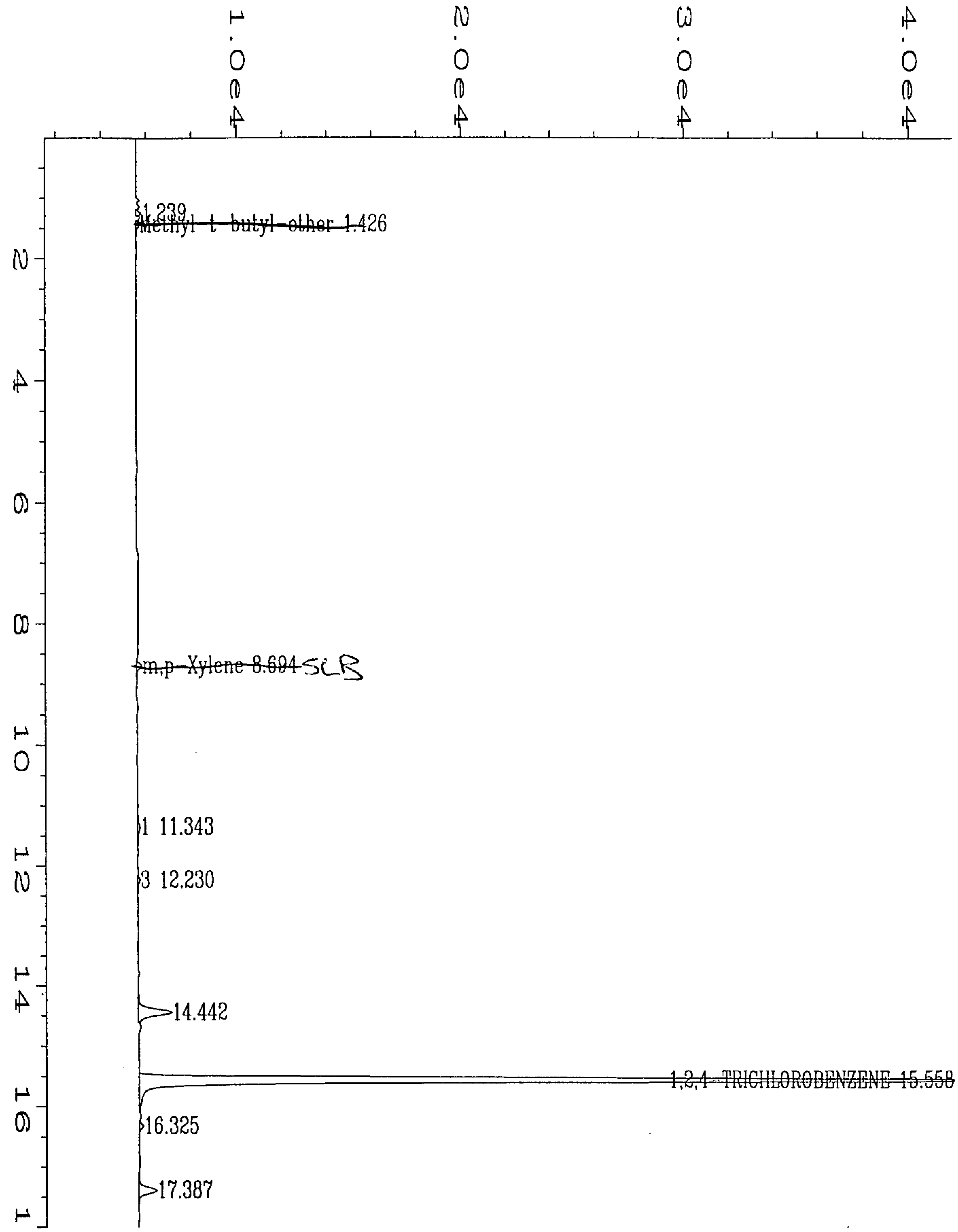
Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

SLB
Analyst

Approved

11/11/98 2:08:41 PM



Data File Name : C:\HPCHEM\1\DATA\TVB11109\061R0101.D
Operator : S. BINGHAM
Instrument : TVHBTEX1
Sample Name : ~~FMB1111198~~
Run Time Bar Code: FMB110998 SLB
Acquired on : 11 Nov 98 12:54 PM
Report Created on: 11 Nov 98 01:21 PM
Last Recalib on : 31 AUG 98 01:18 PM
Multiplier : 1
Sample Info : MBLK TVH_W BTEXM_W

DF=1

Page Number : 1
Vial Number : 61
Injection Number : 1
Sequence Line : 1
Instrument Method: TVH10126.MTH
Analysis Method : BX10831.MTH
Sample Amount : 0
ISTD Amount :

APPENDIX C

CALCULATIONS

APPENDIX C-1

MOBILE LNAPL
WEATHERING CALCULATIONS

Lab	Fuel	Spill	Sample						Smith et al., 1981					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	Benzene	1300000	ug/L	0.1667	0.3333	0.0882	17.65	0.2908	25.23	0.3446	0.0912	17.84	0.2967	25.67
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	Toluene	3000000	ug/L	0.3846	0.9454	0.2502	18.81	0.3284	27.99	1.3361	0.3536	20.55	0.3966	32.74
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	Ethylbenzene	1400000	ug/L	0.1795	0.1905	0.0504	13.63	0.1915	17.43	0.5774	0.1528	20.19	0.3809	31.68
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	o-Xylene	3100000	ug/L	0.3974	0.6126	0.1621	16.05	0.2469	21.88	0.2297	0.0608	9.70	0.1207	11.37
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	m,p-Xylene	5900000	ug/L	0.7564	0.5536	0.1465	11.19	0.1454	13.53	0.9768	0.2585	14.92	0.2195	19.70
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	Total Xylenes (m,p, and o)	9000000	ug/L	1.1538	1.1662	0.3087	13.30	0.1849	16.88	1.2065	0.3193	13.53	0.1894	17.26
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	Total BTEX	14700000	ug/L	1.8846	2.6354	0.6975	15.43	0.2315	20.67	3.4645	0.9170	17.14	0.2761	24.13
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	B+T	4300000	ug/L	0.5513										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	E+X	10400000	ug/L	1.3333										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	B/T	0.43333333		0.0000										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	B/E	0.92857143		0.0000										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	B/X	0.14444444		0.0000										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	T/E	2.14285714		0.0000										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	T/X	0.33333333		0.0000										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	E/X	0.15555556		0.0000										
EAL	JP-4	6/1/94	3/11/98	SH98-1610-2	(B+T)/(E+X)	0.41346154		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	Benzene	2650000	ug/L	0.3464	0.1536	0.0556	11.11	0.1328	12.43	0.1648	0.0596	11.66	0.1408	13.13
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	Toluene	5740000	ug/L	0.7503	0.5797	0.2097	15.77	0.2071	18.70	0.9704	0.3510	20.40	0.3002	25.94
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	Ethylbenzene	1770000	ug/L	0.2314	0.1386	0.0501	13.55	0.1698	15.62	0.5255	0.1901	25.12	0.4287	34.87
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	o-Xylene	3490000	ug/L	0.4562	0.5538	0.2003	19.83	0.2875	24.99	0.1710	0.0618	9.86	0.1151	10.88
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	m,p-Xylene	7490000	ug/L	0.9791	0.3309	0.1197	9.14	0.1053	10.00	0.7541	0.2728	15.74	0.2066	18.66
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	Total Xylenes (m,p, and o)	10980000	ug/L	1.4353	0.8847	0.3200	13.79	0.1737	15.95	0.9251	0.3346	14.18	0.1799	16.47
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	Total BTEX	21140000	ug/L	2.7634	1.7566	0.6354	14.06	0.1780	16.31	2.5857	0.9354	17.49	0.2389	21.25
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	B+T	8390000	ug/L	1.0967										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	E+X	12750000	ug/L	1.6667										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	B/T	0.46167247		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	B/E	1.49717514		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	B/X	0.24134791		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	T/E	3.24293785		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	T/X	0.52276867		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	E/X	0.16120219		0.0000										
EAL	JP-4	6/1/94	3/6/97	SHMW1610-2	(B+T)/(E+X)	0.65803922		0.0000										

Lab	Fuel	Spill	Sample						Smith et al., 1981					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	$C_o - C$	k	%Red./yr	k	%Red./yr	$C_o - C$	k	%Red./yr	k	%Red./yr
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Density	0.78	g/mL	0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Benzene	1250	ug/mL	0.1603	0.3397	0.0899	17.98	0.3012	26.00	0.3510	0.0929	18.17	0.3070	26.44
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Toluene	2830	ug/mL	0.3628	0.9672	0.2560	19.25	0.3438	29.10	1.3579	0.3594	20.89	0.4120	33.77
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Ethylbenzene	1040	ug/mL	0.1333	0.2367	0.0626	16.93	0.2702	23.67	0.6235	0.1650	21.81	0.4596	36.84
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	m-Xylene	3440	ug/mL	0.4410	0.5190	0.1374	14.31	0.2059	18.61	-0.4410	-0.1167	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	o-Xylene	2430	ug/mL	0.3115	0.6985	0.1849	18.30	0.3113	26.75	0.3156	0.0835	13.32	0.1852	16.91
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	p-Xylene	1310	ug/mL	0.1679	0.1821	0.0482	13.77	0.1944	17.66	1.5652	0.4143	23.90	0.6178	46.09
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	m,p-xylenes	4750	ug/mL	0.6090	0.7010	0.1856	14.16	0.2028	18.35	1.1242	0.2976	17.17	0.2768	24.18
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Total Xylenes (m,p, and o)	7180	ug/mL	0.9205	1.3995	0.3704	15.97	0.2447	21.70	1.4398	0.3811	16.15	0.2492	22.06
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Total BTEX	12300	ug/mL	1.5769	2.9431	0.7790	17.23	0.2787	24.33	3.7722	0.9984	18.67	0.3233	27.62
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	B+T	4080	ug/mL	0.5231										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	E+X	8220	ug/mL	1.0538										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	B/T	0.44169611		0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	B/E	1.20192308		0.0002										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	B/X	0.17409471		0.0000										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	T/E	2.72115385		0.0003										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	T/X	0.39415042		0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	E/X	0.1448468		0.0000										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	(B+T)/(E+X)	0.49635036		0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	1,2,3-Trimethylbenzene	3130	ug/mL	0.4013	-0.4013	-0.1062	#DIV/0!	#DIV/0!	#DIV/0!	0.0488	0.0129	2.87	0.0304	2.99
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	1,2,4-Trimethylbenzene	7320	ug/mL	0.9385	0.0715	0.0189	1.87	0.0194	1.93	-0.1218	-0.0322	-3.95	-0.0368	-3.75
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	1,3,5-Trimethylbenzene	2200	ug/mL	0.2821	0.1379	0.0365	8.69	0.1054	10.00	-0.1602	-0.0424	-34.81	-0.2222	-24.88
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Total TMBs	12650	ug/mL	1.6218	-0.1918	-0.0508	-3.55	-0.0333	-3.39	-0.2331	-0.0617	-4.44	-0.0411	-4.19
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Naphthalene	1320	ug/mL	0.1692	0.3308	0.0875	17.51	0.2867	24.93	0.1051	0.0278	10.14	0.1278	12.00
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	1-MethylNaphthalene	1320	ug/mL	0.1692	0.6108	0.1617	20.73	0.4044	33.27	-0.1331	-0.0352	-97.41	-0.4085	-50.45
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	2-MethylNaphthalene	2200	ug/mL	0.2821	0.2779	0.0736	13.14	0.1815	16.60	-0.1237	-0.0327	-20.68	-0.1528	-16.51
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-2	Total Naphthalenes	4840	ug/mL	0.6205	1.2195	0.3228	17.54	0.2877	25.00	-0.1517	-0.0401	-8.56	-0.0742	-7.70
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Density	0.777	g/mL	0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Benzene	1650	ug/mL	0.2124	0.2876	0.0761	15.23	0.2267	20.28	0.2989	0.0791	15.47	0.2325	20.75
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Toluene	3290	ug/mL	0.4234	0.9066	0.2400	18.04	0.3029	26.14	1.2973	0.3434	19.96	0.3711	31.00
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Ethylbenzene	1070	ug/mL	0.1377	0.2323	0.0615	16.62	0.2616	23.02	0.6191	0.1639	21.65	0.4510	36.30
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	m-Xylene	3470	ug/mL	0.4466	0.5134	0.1359	14.16	0.2026	18.34	-0.4466	-0.1182	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	o-Xylene	2450	ug/mL	0.3153	0.6947	0.1839	18.21	0.3081	26.52	0.3119	0.0825	13.16	0.1820	16.64
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	p-Xylene	1290	ug/mL	0.1660	0.1840	0.0487	13.91	0.1974	17.91	1.5671	0.4148	23.93	0.6208	46.25
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	m,p-xylenes	4760	ug/mL	0.6126	0.6974	0.1846	14.09	0.2012	18.22	1.1206	0.2966	17.11	0.2753	24.06
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Total Xylenes (m,p, and o)	7210	ug/mL	0.9279	1.3921	0.3685	15.88	0.2425	21.54	1.4324	0.3791	16.06	0.2471	21.89
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Total BTEX	13220	ug/mL	1.7014	2.8186	0.7460	16.51	0.2586	22.79	3.6477	0.9655	18.05	0.3032	26.15
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	B+T	4940	ug/mL	0.6358										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	E+X	8280	ug/mL	1.0656										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	B/T	0.50151976		0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	B/E	1.54205607		0.0002										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	B/X	0.22884882		0.0000										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	T/E	3.07476636		0.0004										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	T/X	0.45631068		0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	E/X	0.14840499		0.0000										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	(B+T)/(E+X)	0.59661836		0.0001										
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	1,2,3-Trimethylbenzene	2860	ug/mL	0.3681	-0.3681	-0.0974	#DIV/0!	#DIV/0!	#DIV/0!	0.0820	0.0217	4.82	0.0533	5.19
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	1,2,4-Trimethylbenzene	6690	ug/mL	0.8610	0.1490	0.0394	3.90	0.0422	4.14	-0.0443	-0.0117	-1.44	-0.0140	-1.41
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	1,3,5-Trimethylbenzene	2010	ug/mL	0.2587	0.1613	0.0427	10.17	0.1283	12.04	-0.1369	-0.0362	-29.74	-0.1993	-22.06
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Total TMBs	11560	ug/mL	1.4878	-0.0578	-0.0153	-1.07	-0.0105	-1.05	-0.0991	-0.0262	-1.89	-0.0182	-1.84
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Naphthalene	1230	ug/mL	0.1583	0.3417	0.0904	18.09	0.3044	26.24	0.1160	0.0307	11.19	0.1455	13.54
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	1-MethylNaphthalene	1200	ug/mL	0.1544	0.6256	0.1656	21.23	0.4287	34.86	-0.1183	-0.0313	-86.58	-0.3843	-46.86
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	2-MethylNaphthalene	1980	ug/mL	0.2548	0.3052	0.0808	14.42	0.2084	18.81	-0.0965	-0.0255	-16.13	-0.1259	-13.42
NRMRL	JP-4	6/1/94	3/11/98	SH98-1610-3	Total Naphthalenes	4410	ug/mL	0.5676	1.2724	0.3368	18.30	0.3113	26.75	-0.0987	-0.0261	-5.57	-0.0506	-5.19

									Smith et al., 1981					Hughes et al., 1984				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Density	0.765	g/mL	0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Benzene	2250	ug/mL	0.2941	0.2059	0.0745	14.90	0.1920	17.47	0.2171	0.0785	15.36	0.2000	18.13
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Toluene	4890	ug/mL	0.6392	0.6908	0.2499	18.79	0.2650	23.28	1.0815	0.3912	22.74	0.3582	30.11
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Ethylbenzene	1340	ug/mL	0.1752	0.1948	0.0705	19.05	0.2705	23.70	0.5817	0.2104	27.80	0.5294	41.10
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	m-Xylene	4140	ug/mL	0.5412	0.4188	0.1515	15.78	0.2073	18.73	-0.5412	-0.1958	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	o-Xylene	2950	ug/mL	0.3856	0.6244	0.2259	22.36	0.3483	29.41	0.2416	0.0874	13.93	0.1759	16.13
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	p-Xylene	1440	ug/mL	0.1882	0.1618	0.0585	16.72	0.2244	20.10	1.5449	0.5589	32.25	0.8031	55.21
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	m,p-xylenes	5580	ug/mL	0.7294	0.5806	0.2100	16.03	0.2118	19.09	1.0038	0.3631	20.95	0.3131	26.88
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Total Xylenes (m,p, and o)	8530	ug/mL	1.1150	1.2050	0.4359	18.79	0.2650	23.28	1.2453	0.4505	19.09	0.2713	23.76
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Total BTEX	17010	ug/mL	2.2235	2.2965	0.8307	18.38	0.2566	22.63	3.1256	1.1307	21.14	0.3176	27.21
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	B+T	7140	ug/mL	0.9333										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	E+X	9870	ug/mL	1.2902										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	B/T	0.4601227		0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	B/E	1.67910448		0.0002										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	B/X	0.26377491		0.0000										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	T/E	3.64925373		0.0005										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	T/X	0.57327081		0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	E/X	0.15709261		0.0000										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	(B+T)/(E+X)	0.72340426		0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	1,2,3-Trimethylbenzene	2990	ug/mL	0.3908	-0.3908	-0.1414	#DIV/0!	#DIV/0!	#DIV/0!	0.0593	0.0214	4.76	0.0511	4.98
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	1,2,4-Trimethylbenzene	5790	ug/mL	0.7569	0.2531	0.0916	9.07	0.1044	9.91	0.0598	0.0216	2.65	0.0275	2.72
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	1,3,5-Trimethylbenzene	3450	ug/mL	0.4510	-0.0310	-0.0112	-2.67	-0.0257	-2.61	-0.3292	-0.1191	-97.74	-0.4735	-60.56
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Total TMBs	12230	ug/mL	1.5987	-0.1687	-0.0610	-4.27	-0.0403	-4.12	-0.2100	-0.0760	-5.47	-0.0510	-5.23
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Naphthalene	1120	ug/mL	0.1464	0.3536	0.1279	25.58	0.4443	35.87	0.1279	0.0463	16.87	0.2271	20.32
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	1-MethylNaphthalene	1040	ug/mL	0.1359	0.6441	0.2330	29.87	0.6320	46.85	-0.0998	-0.0361	-99.83	-0.4791	-61.46
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	2-MethylNaphthalene	1680	ug/mL	0.2196	0.3404	0.1231	21.99	0.3386	28.73	-0.0613	-0.0222	-13.99	-0.1183	-12.56
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-2	Total Naphthalenes	3840	ug/mL	0.5020	1.3380	0.4840	26.31	0.4699	37.49	-0.0331	-0.0120	-2.56	-0.0247	-2.50
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Density	0.783	g/mL	0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Benzene	1380	ug/mL	0.1762	0.3238	0.1171	23.42	0.3772	31.42	0.3350	0.1212	23.70	0.3852	31.97
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Toluene	2510	ug/mL	0.3206	1.0094	0.3652	27.46	0.5147	40.23	1.4001	0.5065	29.44	0.6079	45.55
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Ethylbenzene	935	ug/mL	0.1194	0.2506	0.0906	24.50	0.4091	33.58	0.6374	0.2306	30.47	0.6680	48.73
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	m-Xylene	3240	ug/mL	0.4138	0.5462	0.1976	20.58	0.3044	26.25	-0.4138	-0.1497	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	o-Xylene	2390	ug/mL	0.3052	0.7048	0.2549	25.24	0.4329	35.14	0.3219	0.1165	18.57	0.2605	22.93
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	p-Xylene	1190	ug/mL	0.1520	0.1980	0.0716	20.47	0.3018	26.05	1.5812	0.5720	33.00	0.8805	58.54
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	m,p-xylenes	4430	ug/mL	0.5658	0.7442	0.2692	20.55	0.3037	26.19	1.1674	0.4223	24.37	0.4050	33.30
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Total Xylenes (m,p, and o)	6820	ug/mL	0.8710	1.4490	0.5242	22.59	0.3544	29.84	1.4893	0.5388	22.83	0.3606	30.28
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Total BTEX	11645	ug/mL	1.4872	3.0328	1.0971	24.27	0.4021	33.11	3.8619	1.3970	26.12	0.4630	37.06
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	B+T	3890	ug/mL	0.4968										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	E+X	7755	ug/mL	0.9904										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	B/T	0.5498008		0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	B/E	1.47593583		0.0002										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	B/X	0.20234604		0.0000										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	T/E	2.68449198		0.0003										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	T/X	0.36803519		0.0000										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	E/X	0.13709677		0.0000										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	(B+T)/(E+X)	0.50161186		0.0001										
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	1,2,3-Trimethylbenzene	3780	ug/mL	0.4828	-0.4828	-0.1746	#DIV/0!	#DIV/0!	#DIV/0!	-0.0326	-0.0118	-2.62	-0.0253	-2.56
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	1,2,4-Trimethylbenzene	7280	ug/mL	0.9298	0.0802	0.0290	2.87	0.0299	2.95	-0.1130	-0.0409	-5.01	-0.0469	-4.80
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	1,3,5-Trimethylbenzene	4110	ug/mL	0.5249	-0.1049	-0.0379	-9.04	-0.0807	-8.40	-0.4031	-0.1458	-119.70	-0.5284	-69.62
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Total TMBs	15170	ug/mL	1.9374	-0.5074	-0.1836	-12.84	-0.1099	-11.61	-0.5488	-0.1985	-14.30	-0.1205	-12.80
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Naphthalene	1440	ug/mL	0.1839	0.3161	0.1143	22.87	0.3618	30.36	0.0904	0.0327	11.92	0.1446	13.47
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	1-MethylNaphthalene	1480	ug/mL	0.1890	0.5910	0.2138	27.41	0.5128	40.12	-0.1529	-0.0553	-152.92	-0.5983	-81.90
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	2-MethylNaphthalene	2490	ug/mL	0.3180	0.2420	0.0875	15.63	0.2047	18.51	-0.1597	-0.0578	-36.47	-0.2522	-28.69
NRMRL	JP-4	6/1/94	3/6/97	SHMW1610-3	Total Naphthalenes	5410	ug/mL	0.6909	1.1491	0.4157	22.59	0.3543	29.84	-0.2221	-0.0803	-17.14	-0.1403	-15.06

									Smith et al., 1981					Hughes et al., 1984				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
EAL	JP-4	1/1/81	3/4/97	MBMW8I	Benzene	211000	ug/L	0.0281	0.4719	0.0292	5.83	0.1778	16.29	0.4831	0.0299	5.84	0.1792	16.41
EAL	JP-4	1/1/81	3/4/97	MBMW8I	Toluene	7540	ug/L	0.0010	1.3290	0.0821	6.18	0.4442	35.87	1.7197	0.1063	6.18	0.4601	36.88
EAL	JP-4	1/1/81	3/4/97	MBMW8I	Ethylbenzene	1830000	ug/L	0.2440	0.1260	0.0078	2.10	0.0257	2.54	0.5129	0.0317	4.19	0.0700	6.76
EAL	JP-4	1/1/81	3/4/97	MBMW8I	o-Xylene	153000	ug/L	0.0204	0.9896	0.0612	6.06	0.2412	21.43	0.6068	0.0375	5.98	0.2117	19.08
EAL	JP-4	1/1/81	3/4/97	MBMW8I	m,p-Xylene	6210000	ug/L	0.8280	0.4820	0.0298	2.27	0.0284	2.80	0.9052	0.0559	3.23	0.0457	4.46
EAL	JP-4	1/1/81	3/4/97	MBMW8I	Total Xylenes (m,p, and o)	6363000	ug/L	0.8484	1.4716	0.0909	3.92	0.0622	6.03	1.5119	0.0934	3.96	0.0632	6.13
EAL	JP-4	1/1/81	3/4/97	MBMW8I	Total BTEX	8411540	ug/L	1.1215	3.3985	0.2100	4.65	0.0861	8.25	4.2276	0.2613	4.88	0.0965	9.20
EAL	JP-4	1/1/81	3/4/97	MBMW8I	B+T	218540	ug/L	0.0291										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	E+X	8193000	ug/L	1.0924										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	B/T	27.98408488		0.0000										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	B/E	0.115300546		0.0000										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	B/X	0.033160459		0.0000										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	T/E	0.004120219		0.0000										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	T/X	0.001184976		0.0000										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	E/X	0.287600189		0.0000										
EAL	JP-4	1/1/81	3/4/97	MBMW8I	(B+T)/(E+X)	0.02667399		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Density	0.75	g/mL	0.0001										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Benzene	211	ug/mL	0.0281	0.4719	0.0292	5.83	0.1778	16.29	0.4831	0.0299	5.84	0.1792	16.41
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Toluene	7.54	ug/mL	0.0010	1.3290	0.0821	6.18	0.4442	35.87	1.7197	0.1063	6.18	0.4601	36.88
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Ethylbenzene	1360	ug/mL	0.1813	0.1887	0.0117	3.15	0.0441	4.31	0.5755	0.0356	4.70	0.0883	8.45
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	m-Xylene	3440	ug/mL	0.4587	0.5013	0.0310	3.23	0.0456	4.46	-0.4587	-0.0283	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	o-Xylene	12.1	ug/mL	0.0016	1.0084	0.0623	6.17	0.3980	32.83	0.6256	0.0387	6.16	0.3685	30.82
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	p-Xylene	810	ug/mL	0.1080	0.2420	0.0150	4.27	0.0727	7.01	1.6252	0.1004	5.80	0.1715	15.76
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	m,p-xylenes	4250	ug/mL	0.5667	0.7433	0.0459	3.51	0.0518	5.05	1.1665	0.0721	4.16	0.0691	6.68
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Total Xylenes (m,p, and o)	4262.1	ug/mL	0.5683	1.7517	0.1083	4.67	0.0869	8.33	1.7921	0.1108	4.69	0.0880	8.42
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Total BTEX	5840.64	ug/mL	0.7788	3.7412	0.2312	5.12	0.1087	10.30	4.5704	0.2825	5.28	0.1191	11.23
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	B+T	218.54	ug/mL	0.0291										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	E+X	5622.1	ug/mL	0.7496										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	B/T	27.98408488		0.0037										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	B/E	0.155147059		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	B/X	0.049506112		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	T/E	0.005544118		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	T/X	0.001769081		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	E/X	0.319091528		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	(B+T)/(E+X)	0.038871596		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	1,2,3-Trimethylbenzene	2580	ug/mL	0.3440	-0.3440	-0.0213	#DIV/0!	#DIV/0!	#DIV/0!	0.1061	0.0066	1.46	0.0166	1.65
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	1,2,4-Trimethylbenzene	5160	ug/mL	0.8213	0.1887	0.0117	1.15	0.0128	1.27	-0.0046	-0.0003	-0.03	-0.0003	-0.03
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	1,3,5-Trimethylbenzene	3550	ug/mL	0.4733	-0.0533	-0.0033	-0.78	-0.0074	-0.74	-0.3515	-0.0217	-17.83	-0.0839	-8.75
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Total TMBs	12290	ug/mL	1.6387	-0.2087	-0.0129	-0.90	-0.0084	-0.85	-0.2500	-0.0155	-1.11	-0.0102	-1.03
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Naphthalene	1160	ug/mL	0.1547	0.3453	0.0213	4.27	0.0725	6.99	0.1196	0.0074	2.70	0.0354	3.48
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	1-MethylNaphthalene	1300	ug/mL	0.1733	0.6067	0.0375	4.81	0.0930	8.88	-0.1372	-0.0085	-23.44	-0.0969	-10.17
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	2-MethylNaphthalene	1910	ug/mL	0.2547	0.3053	0.0189	3.37	0.0487	4.75	-0.0963	-0.0060	-3.76	-0.0294	-2.98
NRMRL	JP-4	1/1/81	3/4/97	MBMW8I	Total Naphthalenes	4370	ug/mL	0.5827	1.2573	0.0777	4.22	0.0711	6.86	-0.1138	-0.0070	-1.50	-0.0134	-1.35

Lab	Fuel	Spill	Sample						Smith et al., 1981					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Density	0.764	g/mL	0.0001										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Benzene	56.2	ug/mL	0.0074	0.4926	0.0304	6.09	0.2607	22.95	0.5039	0.0311	6.09	0.2621	23.06
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Toluene	5.57	ug/mL	0.0007	1.3293	0.0822	6.18	0.4641	37.13	1.7200	0.1063	6.18	0.4800	38.12
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Ethylbenzene	600	ug/mL	0.0785	0.2915	0.0180	4.87	0.0958	9.13	0.6783	0.0419	5.54	0.1400	13.07
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	m-Xylene	1810	ug/mL	0.2369	0.7231	0.0447	4.66	0.0865	8.28	-0.2369	-0.0146	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	o-Xylene	14.2	ug/mL	0.0019	1.0081	0.0623	6.17	0.3892	32.24	0.6253	0.0386	6.16	0.3598	30.22
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	p-Xylene	313	ug/mL	0.0410	0.3090	0.0191	5.46	0.1326	12.42	1.6922	0.1046	6.03	0.2314	20.66
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	m,p-xylenes	2123	ug/mL	0.2779	1.0321	0.0638	4.87	0.0958	9.14	1.4553	0.0899	5.19	0.1131	10.70
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Total Xylenes (m,p, and o)	2137.2	ug/mL	0.2797	2.0403	0.1261	5.43	0.1307	12.26	2.0806	0.1286	5.45	0.1318	12.35
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Total BTEX	2798.97	ug/mL	0.3664	4.1536	0.2567	5.68	0.1553	14.38	4.9828	0.3079	5.76	0.1657	15.27
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	B+T	61.77	ug/mL	0.0081										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	E+X	2737.2	ug/mL	0.3583										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	B/T	10.08976661		0.0013										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	B/E	0.093666667		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	B/X	0.026296088		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	T/E	0.009283333		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	T/X	0.002606214		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	E/X	0.280741157		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	(B+T)/(E+X)	0.022566857		0.0000										
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	1,2,3-Trimethylbenzene	2980	ug/mL	0.3901	-0.3901	-0.0241	#DIV/0!	#DIV/0!	#DIV/0!	0.0601	0.0037	0.82	0.0089	0.88
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	1,2,4-Trimethylbenzene	6500	ug/mL	0.8508	0.1592	0.0098	0.97	0.0106	1.05	-0.0341	-0.0021	-0.26	-0.0025	-0.25
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	1,3,5-Trimethylbenzene	2840	ug/mL	0.3717	0.0483	0.0030	0.71	0.0075	0.75	-0.2499	-0.0154	-12.68	-0.0689	-7.14
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Total TMBs	12320	ug/mL	1.6126	-0.1826	-0.0113	-0.79	-0.0074	-0.75	-0.2239	-0.0138	-1.00	-0.0092	-0.93
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Naphthalene	892	ug/mL	0.1168	0.3832	0.0237	4.74	0.0899	8.60	0.1576	0.0097	3.55	0.0528	5.14
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	1-MethylNaphthalene	1320	ug/mL	0.1728	0.6072	0.0375	4.81	0.0932	8.89	-0.1366	-0.0084	-23.35	-0.0967	-10.15
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	2-MethylNaphthalene	1810	ug/mL	0.2369	0.3231	0.0200	3.57	0.0532	5.18	-0.0786	-0.0049	-3.07	-0.0249	-2.52
NRMRL	JP-4	1/1/81	3/4/97	MBMW24	Total Naphthalenes	4022	ug/mL	0.5264	1.3136	0.0812	4.41	0.0773	7.44	-0.0576	-0.0036	-0.76	-0.0072	-0.72

									Smith et al., 1981					Hughes et al., 1984				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
EAL	JP-4	10/1/75	5/17/97	CH-EW6	Benzene	25	ug/L	0.0000	0.5000	0.0231	4.62	0.5535	42.51	0.5112	0.0236	4.62	0.5545	42.56
EAL	JP-4	10/1/75	5/17/97	CH-EW6	Toluene	1350	ug/L	0.0002	1.3298	0.0614	4.62	0.4144	33.92	1.7205	0.0795	4.62	0.4263	34.71
EAL	JP-4	10/1/75	5/17/97	CH-EW6	Ethylbenzene	91300	ug/L	0.0115	0.3585	0.0166	4.48	0.1605	14.83	0.7454	0.0344	4.55	0.1936	17.60
EAL	JP-4	10/1/75	5/17/97	CH-EW6	Total Xylenes (m,p, and o)	2100000	ug/L	0.2638	2.0562	0.0950	4.10	0.1005	9.56	2.0965	0.0969	4.10	0.1013	9.63
EAL	JP-4	10/1/75	5/17/97	CH-EW6	Total BTEX	2192675	ug/L	0.2755	4.2445	0.1961	4.34	0.1293	12.13	5.0737	0.2344	4.38	0.1371	12.81
EAL	JP-4	10/1/75	5/17/97	CH-EW6	B+T	1375	ug/L	0.0002										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	E+X	2191300	ug/L	0.2753										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	B/T	0.01851852		0.0000										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	B/E	0.00027382		0.0000										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	B/X	1.1905E-05		0.0000										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	T/E	0.01478642		0.0000										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	T/X	0.00064286		0.0000										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	E/X	0.04347619		0.0000										
EAL	JP-4	10/1/75	5/17/97	CH-EW6	(B+T)/(E+X)	0.00062748		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	Benzene	25	ug/L	0.0000	0.5000	0.0231	4.62	0.5514	42.39	0.5112	0.0236	4.62	0.5524	42.45
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	Toluene	204000	ug/L	0.0268	1.3032	0.0602	4.53	0.1804	16.50	1.6939	0.0783	4.55	0.1923	17.49
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	Ethylbenzene	960000	ug/L	0.1263	0.2437	0.0113	3.04	0.0497	4.85	0.6305	0.0291	3.85	0.0827	7.94
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	Total Xylenes (m,p, and o)	5400000	ug/L	0.7105	1.6095	0.0744	3.21	0.0547	5.32	1.6498	0.0762	3.23	0.0555	5.40
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	Total BTEX	6564025	ug/L	0.8637	3.6563	0.1690	3.74	0.0765	7.36	4.4854	0.2073	3.88	0.0843	8.08
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	B+T	204025	ug/L	0.0268										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	E+X	6360000	ug/L	0.8368										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	B/T	0.00012255		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	B/E	2.6042E-05		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	B/X	4.6296E-06		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	T/E	0.2125		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	T/X	0.03777778		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	E/X	0.17777778		0.0000										
EAL	JP-4	10/1/75	5/16/97	CH-MW-103	(B+T)/(E+X)	0.0320794		0.0000										

Lab	Fuel	Spill	Sample						Smith et al., 1981					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Density	0.8057	g/mL	0.0001										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Benzene	10.5	ug/mL	0.0013	0.4987	0.0274	5.49	0.3273	27.91	0.5099	0.0280	5.49	0.3285	28.00
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Toluene	45.8	ug/mL	0.0057	1.3243	0.0728	5.48	0.3001	25.92	1.7150	0.0943	5.48	0.3142	26.96
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Ethylbenzene	385	ug/mL	0.0478	0.3222	0.0177	4.79	0.1126	10.65	0.7091	0.0390	5.15	0.1519	14.10
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	m-Xylene	1070	ug/mL	0.1328	0.8272	0.0455	4.74	0.1088	10.31	-0.1328	-0.0073	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	o-Xylene	92.5	ug/mL	0.0115	0.9985	0.0549	5.44	0.2463	21.83	0.6157	0.0339	5.40	0.2200	19.75
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	p-Xylene	345	ug/mL	0.0428	0.3072	0.0169	4.83	0.1156	10.91	1.6903	0.0930	5.36	0.2035	18.42
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	m,p-xylenes	1415	ug/mL	0.1756	1.1344	0.0624	4.76	0.1105	10.46	1.5575	0.0857	4.94	0.1259	11.83
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Total Xylenes (m,p, and o)	1507.5	ug/mL	0.1871	2.1329	0.1173	5.06	0.1385	12.93	2.1732	0.1195	5.06	0.1394	13.01
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Total BTEX	1948.8	ug/mL	0.2419	4.2781	0.2353	5.21	0.1610	14.87	5.1073	0.2809	5.25	0.1703	15.66
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	B+T	56.3	ug/mL	0.0070										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	E+X	1892.5	ug/mL	0.2349										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	B/T	0.22925764		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	B/E	0.02727273		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	B/X	0.00696517		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	T/E	0.11896104		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	T/X	0.03038143		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	E/X	0.25538972		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	(B+T)/(E+X)	0.02974901		0.0000										
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	1,2,3-Trimethylbenzene	627	ug/mL	0.0778	-0.0778	-0.0043	#DIV/0!	#DIV/0!	#DIV/0!	0.3723	0.0205	4.55	0.0965	9.20
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	1,2,4-Trimethylbenzene	1410	ug/mL	0.1750	0.8350	0.0459	4.55	0.0964	9.19	0.6417	0.0353	4.32	0.0847	8.12
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	1,3,5-Trimethylbenzene	799	ug/mL	0.0992	0.3208	0.0176	4.20	0.0794	7.63	0.0227	0.0012	1.02	0.0113	1.13
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Total TMBs	2836	ug/mL	0.3520	1.0780	0.0593	4.15	0.0771	7.42	1.0367	0.0570	4.11	0.0755	7.27
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Naphthalene	469	ug/mL	0.0582	0.4418	0.0243	4.86	0.1183	11.16	0.2161	0.0119	4.33	0.0853	8.17
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	1-MethylNaphthalene	1530	ug/mL	0.1899	0.5901	0.0325	4.16	0.0777	7.48	-0.1537	-0.0085	-23.39	-0.0912	-9.55
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	2-MethylNaphthalene	1810	ug/mL	0.2246	0.3354	0.0184	3.29	0.0502	4.90	-0.0663	-0.0036	-2.30	-0.0192	-1.94
NRMRL	JP-4	10/1/75	12/1/93	CH-EW6	Total Naphthalenes	3809	ug/mL	0.4728	1.3672	0.0752	4.09	0.0747	7.20	-0.0039	-0.0002	-0.05	-0.0005	-0.05
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Density	0.796	g/mL	0.0001										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Benzene	0.025	ug/mL	0.0000	0.5000	0.0231	4.62	0.5535	42.51	0.5112	0.0236	4.62	0.5545	42.56
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Toluene	1.35	ug/mL	0.0002	1.3298	0.0614	4.62	0.4144	33.92	1.7205	0.0795	4.62	0.4263	34.71
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Ethylbenzene	91.3	ug/mL	0.0115	0.3585	0.0166	4.48	0.1605	14.83	0.7454	0.0344	4.55	0.1936	17.60
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	m-Xylene	220	ug/mL	0.0276	0.9324	0.0431	4.49	0.1639	15.12	-0.0276	-0.0013	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	o-Xylene	21.2	ug/mL	0.0027	1.0073	0.0465	4.61	0.2744	24.00	0.6245	0.0289	4.60	0.2524	22.30
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	p-Xylene	110	ug/mL	0.0138	0.3362	0.0155	4.44	0.1493	13.87	1.7193	0.0794	4.58	0.2233	20.01
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	m,p-xylenes	330	ug/mL	0.0415	1.2685	0.0586	4.47	0.1596	14.75	1.6917	0.0782	4.51	0.1725	15.84
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Total Xylenes (m,p, and o)	351.2	ug/mL	0.0441	2.2759	0.1052	4.53	0.1831	16.73	2.3162	0.1070	4.53	0.1839	16.80
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Total BTEX	443.875	ug/mL	0.0558	4.4642	0.2063	4.56	0.2031	18.38	5.2934	0.2446	4.57	0.2109	19.01
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	B+T	1.375	ug/mL	0.0002										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	E+X	442.5	ug/mL	0.0556										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	B/T	0.01851852		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	B/E	0.00027382		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	B/X	7.1185E-05		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	T/E	0.01478642		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	T/X	0.00384396		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	E/X	0.25996583		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	(B+T)/(E+X)	0.00310734		0.0000										
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	1,2,3-Trimethylbenzene	448	ug/mL	0.0563	-0.0563	-0.0026	#DIV/0!	#DIV/0!	#DIV/0!	0.3938	0.0182	4.04	0.0961	9.16
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	1,2,4-Trimethylbenzene	764	ug/mL	0.0960	0.9140	0.0422	4.18	0.1088	10.30	0.7207	0.0333	4.08	0.0989	9.42
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	1,3,5-Trimethylbenzene	541	ug/mL	0.0680	0.3520	0.0163	3.87	0.0842	8.07	0.0539	0.0025	2.04	0.0270	2.66
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Total TMBs	1753	ug/mL	0.2202	1.2098	0.0559	3.91	0.0864	8.28	1.1684	0.0540	3.89	0.0851	8.16
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Naphthalene	446	ug/mL	0.0560	0.4440	0.0205	4.10	0.1011	9.62	0.2183	0.0101	3.68	0.0734	7.08
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	1-MethylNaphthalene	1480	ug/mL	0.1859	0.5941	0.0275	3.52	0.0663	6.41	-0.1498	-0.0069	-19.14	-0.0757	-7.86
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	2-MethylNaphthalene	1750	ug/mL	0.2198	0.3402	0.0157	2.81	0.0432	4.23	-0.0615	-0.0028	-1.79	-0.0152	-1.53
NRMRL	JP-4	10/1/75	5/17/97	CH-EW6	Total Naphthalenes	3676	ug/mL	0.4618	1.3782	0.0637	3.46	0.0639	6.19	0.0070	0.0003	0.07	0.0007	0.07

									Smith et al., 1981					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Lab Code	Fuel Type	Spill Date	Sample Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Density	0.76	g/mL	0.0001										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Benzene	0.025	ug/mL	0.0000	0.5000	0.0231	4.62	0.5514	42.39	0.5112	0.0236	4.62	0.5524	42.45
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Toluene	204	ug/mL	0.0268	1.3032	0.0602	4.53	0.1804	16.50	1.6939	0.0783	4.55	0.1923	17.49
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Ethylbenzene	856	ug/mL	0.1126	0.2574	0.0119	3.21	0.0550	5.35	0.6442	0.0298	3.93	0.0880	8.43
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	m-Xylene	2430	ug/mL	0.3197	0.6403	0.0296	3.08	0.0508	4.95	-0.3197	-0.0148	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	o-Xylene	1000	ug/mL	0.1316	0.8784	0.0406	4.02	0.0942	8.99	0.4956	0.0229	3.65	0.0722	6.96
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	p-Xylene	968	ug/mL	0.1274	0.2226	0.0103	2.94	0.0467	4.56	1.6058	0.0742	4.28	0.1206	11.37
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	m,p-xylenes	3398	ug/mL	0.4471	0.8629	0.0399	3.04	0.0497	4.85	1.2861	0.0594	3.43	0.0626	6.07
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Total Xylenes (m,p, and o)	4398	ug/mL	0.5787	1.7413	0.0805	3.47	0.0642	6.22	1.7817	0.0823	3.49	0.0650	6.29
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Total BTEX	5458.025	ug/mL	0.7182	3.8018	0.1757	3.89	0.0850	8.15	4.6310	0.2140	4.00	0.0928	8.86
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	B+T	204.025	ug/mL	0.0268										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	E+X	5254	ug/mL	0.6913										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	B/T	0.00012255		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	B/E	2.9206E-05		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	B/X	5.6844E-06		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	T/E	0.23831776		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	T/X	0.04638472		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	E/X	0.19463392		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	(B+T)/(E+X)	0.03883232		0.0000										
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	1,2,3-Trimethylbenzene	953	ug/mL	0.1254	-0.1254	-0.0058	#DIV/0!	#DIV/0!	#DIV/0!	0.3247	0.0150	3.33	0.0591	5.74
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	1,2,4-Trimethylbenzene	2180	ug/mL	0.2868	0.7232	0.0334	3.31	0.0582	5.65	0.5299	0.0245	3.00	0.0484	4.72
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	1,3,5-Trimethylbenzene	1040	ug/mL	0.1368	0.2832	0.0131	3.12	0.0518	5.05	-0.0150	-0.0007	-0.57	-0.0054	-0.54
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Total TMBs	4173	ug/mL	0.5491	0.8809	0.0407	2.85	0.0442	4.33	0.8396	0.0388	2.79	0.0429	4.20
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Naphthalene	502	ug/mL	0.0661	0.4339	0.0201	4.01	0.0935	8.93	0.2083	0.0096	3.51	0.0658	6.37
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	1-MethylNaphthalene	1400	ug/mL	0.1842	0.5958	0.0275	3.53	0.0667	6.45	-0.1481	-0.0068	-18.92	-0.0752	-7.81
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	2-MethylNaphthalene	1800	ug/mL	0.2368	0.3232	0.0149	2.67	0.0398	3.90	-0.0785	-0.0036	-2.29	-0.0186	-1.88
NRMRL	JP-4	10/1/75	5/16/97	CH-MW-103	Total Naphthalenes	3702	ug/mL	0.4871	1.3529	0.0625	3.40	0.0614	5.96	-0.0183	-0.0008	-0.18	-0.0018	-0.18
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Density	0.775	g/mL	0.0001										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Benzene	209	ug/mL	0.0270	0.4730	0.0241	4.83	0.1490	13.84	0.4843	0.0247	4.83	0.1502	13.94
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Toluene	45.4	ug/mL	0.0059	1.3241	0.0676	5.08	0.2769	24.18	1.7148	0.0875	5.09	0.2900	25.17
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Ethylbenzene	2120	ug/mL	0.2735	0.0965	0.0049	1.33	0.0154	1.53	0.4833	0.0247	3.26	0.0519	5.06
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	m-Xylene	4620	ug/mL	0.5961	0.3639	0.0186	1.93	0.0243	2.40	-0.5961	-0.0304	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	o-Xylene	353	ug/mL	0.0455	0.9645	0.0492	4.87	0.1582	14.63	0.5816	0.0297	4.73	0.1338	12.53
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	p-Xylene	1680	ug/mL	0.2168	0.1332	0.0068	1.94	0.0244	2.42	1.5164	0.0774	4.47	0.1061	10.07
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	m,p-xylenes	6300	ug/mL	0.8129	0.4971	0.0254	1.94	0.0244	2.41	0.9203	0.0470	2.71	0.0386	3.79
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Total Xylenes (m,p, and o)	6653	ug/mL	0.8585	1.4615	0.0746	3.22	0.0507	4.95	1.5019	0.0766	3.25	0.0516	5.03
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Total BTEX	9027.4	ug/mL	1.1648	3.3552	0.1712	3.79	0.0692	6.69	4.1843	0.2135	3.99	0.0778	7.48
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	B+T	254.4	ug/mL	0.0328										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	E+X	8773	ug/mL	1.1320										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	B/T	4.60352423		0.0006										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	B/E	0.09858491		0.0000										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	B/X	0.0314144		0.0000										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	T/E	0.02141509		0.0000										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	T/X	0.00682399		0.0000										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	E/X	0.31865324		0.0000										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	(B+T)/(E+X)	0.02899806		0.0000										
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	1,2,3-Trimethylbenzene	986	ug/mL	0.1272	-0.1272	-0.0065	#DIV/0!	#DIV/0!	#DIV/0!	0.3229	0.0165	3.66	0.0645	6.25
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	1,2,4-Trimethylbenzene	2670	ug/mL	0.3445	0.6655	0.0340	3.36	0.0549	5.34	0.4722	0.0241	2.95	0.0441	4.31
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	1,3,5-Trimethylbenzene	1130	ug/mL	0.1458	0.2742	0.0140	3.33	0.0540	5.26	-0.0240	-0.0012	-1.00	-0.0092	-0.92
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Total TMBs	4786	ug/mL	0.6175	0.8125	0.0415	2.90	0.0429	4.19	0.7711	0.0394	2.83	0.0414	4.05
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Naphthalene	1050	ug/mL	0.1355	0.3645	0.0186	3.72	0.0666	6.45	0.1388	0.0071	2.58	0.0360	3.54
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	1-MethylNaphthalene	1590	ug/mL	0.2052	0.5748	0.0293	3.76	0.0682	6.59	-0.1690	-0.0086	-23.85	-0.0886	-9.26
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	2-MethylNaphthalene	2090	ug/mL	0.2697	0.2903	0.0148	2.65	0.0373	3.66	-0.1113	-0.0057	-3.59	-0.0272	-2.75
NRMRL	JP-4	10/1/75	5/1/95	WQ27B	Total Naphthalenes	4730	ug/mL	0.6103	1.2297	0.0628	3.41	0.0563	5.48	-0.1415	-0.0072	-1.54	-0.0135	-1.36
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Density	0.73	g/mL	0.0001										

Lab Code	Fuel Type	Spill Date	Sample Date	LocId	Analyte	Results	Units	Mass Fraction	Smith et al., 1981 $C_o - C$	Smith Linear k	Smith Linear %Red./yr	Smith Exponential k	Smith Exponential %Red./yr	Hughes et al., 1984 $C_o - C$	Hughes Linear k	Hughes Linear %Red./yr	Hughes Exponential k	Hughes Exponential %Red./yr
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Benzene	1780	ug/mL	0.2438	0.2562	0.1227	24.54	0.3440	29.11	0.2674	0.1281	25.05	0.3546	29.86
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Toluene	6650	ug/mL	0.9110	0.4190	0.2007	15.09	0.1813	16.58	0.8097	0.3879	22.54	0.3046	26.26
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Ethylbenzene	1540	ug/mL	0.2110	0.1590	0.0762	20.59	0.2691	23.60	0.5459	0.2615	34.55	0.6119	45.77
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	m-Xylene	3800	ug/mL	0.5205	0.4395	0.2105	21.93	0.2932	25.41	-0.5205	-0.2493	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	o-Xylene	2510	ug/mL	0.3438	0.6662	0.3191	31.59	0.5161	40.32	0.2833	0.1357	21.64	0.2879	25.02
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	p-Xylene	1790	ug/mL	0.2452	0.1048	0.0502	14.34	0.1704	15.67	1.4880	0.7127	41.12	0.9367	60.81
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	m,p-xylenes	5590	ug/mL	0.7658	0.5442	0.2607	19.90	0.2572	22.68	0.9674	0.4634	26.74	0.3913	32.38
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Total Xylenes (m,p, and o)	8100	ug/mL	1.1096	1.2104	0.5798	24.99	0.3533	29.76	1.2508	0.5991	25.38	0.3616	30.34
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Total BTEX	18070	ug/mL	2.4753	2.0447	0.9794	21.67	0.2884	25.06	2.8738	1.3766	25.73	0.3691	30.86
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	B+T	8430	ug/mL	1.1548										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	E+X	9640	ug/mL	1.3205										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	B/T	0.26766917		0.0000										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	B/E	1.15584416		0.0002										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	B/X	0.21975309		0.0000										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	T/E	4.31818182		0.0006										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	T/X	0.82098765		0.0001										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	E/X	0.19012346		0.0000										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	(B+T)/(E+X)	0.87448133		0.0001										
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	1,2,3-Trimethylbenzene	3180	ug/mL	0.4356	-0.4356	-0.2087	#DIV/0!	#DIV/0!	#DIV/0!	0.0145	0.0069	1.54	0.0157	1.56
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	1,2,4-Trimethylbenzene	7720	ug/mL	1.0575	-0.0475	-0.0228	-2.25	-0.0220	-2.23	-0.2408	-0.1154	-14.12	-0.1238	-13.18
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	1,3,5-Trimethylbenzene	2210	ug/mL	0.3027	0.1173	0.0562	13.37	0.1568	14.51	-0.1809	-0.0867	-71.14	-0.4360	-54.66
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Total TMBs	13110	ug/mL	1.7959	-0.3659	-0.1753	-12.26	-0.1091	-11.53	-0.4072	-0.1951	-14.05	-0.1232	-13.11
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Naphthalene	1080	ug/mL	0.1479	0.3521	0.1686	33.73	0.5833	44.20	0.1264	0.0605	22.07	0.2958	25.60
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	1-MethylNaphthalene	1160	ug/mL	0.1589	0.6211	0.2975	38.14	0.7621	53.33	-0.1227	-0.0588	-162.60	-0.7091	-103.22
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	2-MethylNaphthalene	1870	ug/mL	0.2562	0.3038	0.1455	25.99	0.3746	31.25	-0.0978	-0.0469	-29.59	-0.2304	-25.91
NRMRL	JP-4	5/1/95	6/1/97	JP4-DFSP	Total Naphthalenes	4110	ug/mL	0.5630	1.2770	0.6117	33.24	0.5672	43.29	-0.0942	-0.0451	-9.62	-0.0877	-9.16

									Smith et al., 1981					Hughes et al., 1984				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Benzene	2000000	ug/L	0.2596	0.2404	0.0100	2.01	0.0274	2.70	0.2516	0.0105	2.06	0.0283	2.79
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Toluene	1000000	ug/L	0.1298	1.2002	0.0502	3.77	0.0973	9.27	1.5909	0.0665	3.87	0.1080	10.24
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Ethylbenzene	5500000	ug/L	0.7139	-0.3439	-0.0144	-3.89	-0.0275	-2.79	0.0429	0.0018	0.24	0.0024	0.24
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	o-Xylene	4300000	ug/L	0.5582	0.4518	0.0189	1.87	0.0248	2.45	0.0690	0.0029	0.46	0.0049	0.49
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	m,p-Xylene	22000000	ug/L	2.8557	-1.5457	-0.0646	-4.93	-0.0326	-3.31	-1.1225	-0.0469	-2.71	-0.0209	-2.11
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Total Xylenes (m,p, and o)	26300000	ug/L	3.4138	-1.0938	-0.0457	-1.97	-0.0161	-1.63	-1.0535	-0.0440	-1.87	-0.0154	-1.55
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Total BTEX	34800000	ug/L	4.5171	0.0029	0.0001	0.00	0.0000	0.00	0.8320	0.0348	0.65	0.0071	0.70
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B+T	3000000	ug/L	0.3894										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	E+X	31800000	ug/L	4.1277										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B/T	2		0.0000										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B/E	0.36363636		0.0000										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B/X	0.07604563		0.0000										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	T/E	0.18181818		0.0000										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	T/X	0.03802281		0.0000										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	E/X	0.20912548		0.0000										
EAL	JP-4	10/1/73	8/27/97	EAKMW316-FP	(B+T)/(E+X)	0.09433962		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Density	0.7704	g/mL	0.0001										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Benzene	900	ug/mL	0.1168	0.3832	0.0160	3.20	0.0608	5.90	0.3944	0.0165	3.23	0.0617	5.98
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Toluene	0.025	ug/mL	0.0000	1.3300	0.0556	4.18	0.5403	41.74	1.7207	0.0719	4.18	0.5510	42.36
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Ethylbenzene	2960	ug/mL	0.3842	-0.0142	-0.0006	-0.16	-0.0016	-0.16	0.3726	0.0156	2.06	0.0283	2.79
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	m-Xylene	8880	ug/mL	1.1526	-0.1926	-0.0081	-0.84	-0.0076	-0.77	-1.1526	-0.0482	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	o-Xylene	2400	ug/mL	0.3115	0.6985	0.0292	2.89	0.0492	4.80	0.3157	0.0132	2.10	0.0293	2.88
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	p-Xylene	4120	ug/mL	0.5348	-0.1848	-0.0077	-2.21	-0.0177	-1.79	1.1984	0.0501	2.89	0.0492	4.80
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	m,p-xylenes	13000	ug/mL	1.6874	-0.3774	-0.0158	-1.20	-0.0106	-1.06	0.0457	0.0019	0.11	0.0011	0.11
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Total Xylenes (m,p, and o)	15400	ug/mL	1.9990	0.3210	0.0134	0.58	0.0062	0.62	0.3614	0.0151	0.64	0.0069	0.69
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Total BTEX	19260.025	ug/mL	2.5000	2.0200	0.0844	1.87	0.0248	2.45	2.8491	0.1191	2.23	0.0318	3.1[illegible]
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B+T	900.025	ug/mL	0.1168										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	E+X	18360	ug/mL	2.3832										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B/T	36000		4.6729										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B/E	0.30405405		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	B/X	0.05844156		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	T/E	8.4459E-06		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	T/X	1.6234E-06		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	E/X	0.19220779		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	(B+T)/(E+X)	0.04902097		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	1,2,3-Trimethylbenzene	3440	ug/mL	0.4465	-0.4465	-0.0187	#DIV/0!	#DIV/0!	#DIV/0!	0.0036	0.0002	0.03	0.0003	0.03
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	1,2,4-Trimethylbenzene	9610	ug/mL	1.2474	-0.2374	-0.0099	-0.98	-0.0088	-0.89	-0.4307	-0.0180	-2.20	-0.0177	-1.79
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	1,3,5-Trimethylbenzene	4980	ug/mL	0.6464	-0.2264	-0.0095	-2.25	-0.0180	-1.82	-0.5246	-0.0219	-18.00	-0.0698	-7.23
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Total TMBs	18030	ug/mL	2.3403	-0.9103	-0.0381	-2.66	-0.0206	-2.08	-0.9517	-0.0398	-2.87	-0.0218	-2.21
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Naphthalene	1000	ug/mL	0.1298	0.3702	0.0155	3.10	0.0564	5.48	0.1445	0.0060	2.20	0.0313	3.08
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	1-MethylNaphthalene	1610	ug/mL	0.2090	0.5710	0.0239	3.06	0.0551	5.36	-0.1728	-0.0072	-19.98	-0.0733	-7.61
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	2-MethylNaphthalene	2900	ug/mL	0.3764	0.1836	0.0077	1.37	0.0166	1.65	-0.2181	-0.0091	-5.76	-0.0362	-3.69
NRMRL	JP-4	10/1/73	8/27/97	EAKMW316-FP	Total Naphthalenes	5510	ug/mL	0.7152	1.1248	0.0470	2.56	0.0395	3.87	-0.2464	-0.0103	-2.20	-0.0177	-1.78

									Smith et al., 1981					Hughes et al., 1984				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Density	0.7626	g/mL	0.0001										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Benzene	2.7	ug/mL	0.0004	0.4996	0.0209	4.18	0.3032	26.16	0.5109	0.0214	4.18	0.3041	26.22
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Toluene	0.025	ug/mL	0.0000	1.3300	0.0556	4.18	0.5398	41.72	1.7207	0.0719	4.18	0.5506	42.34
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Ethylbenzene	2480	ug/mL	0.3252	0.0448	0.0019	0.51	0.0054	0.54	0.4317	0.0180	2.38	0.0353	3.47
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	m-Xylene	530	ug/mL	0.0695	0.8905	0.0372	3.88	0.1098	10.40	-0.0695	-0.0029	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	o-Xylene	1690	ug/mL	0.2216	0.7884	0.0330	3.26	0.0634	6.14	0.4056	0.0170	2.70	0.0435	4.26
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	p-Xylene	2930	ug/mL	0.3842	-0.0342	-0.0014	-0.41	-0.0039	-0.39	1.3490	0.0564	3.25	0.0630	6.10
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	m,p-xylenes	3460	ug/mL	0.4537	0.8563	0.0358	2.73	0.0443	4.34	1.2795	0.0535	3.09	0.0560	5.45
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Total Xylenes (m,p, and o)	5150	ug/mL	0.6753	1.6447	0.0688	2.96	0.0516	5.03	1.6850	0.0704	2.98	0.0523	5.10
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Total BTEX	7632.725	ug/mL	1.0009	3.5191	0.1471	3.25	0.0630	6.11	4.3482	0.1818	3.40	0.0701	6.77
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	B+T	2.725	ug/mL	0.0004										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	E+X	7630	ug/mL	1.0005										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	B/T	108		0.0142										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	B/E	0.00108871		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	B/X	0.00052427		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	T/E	1.0081E-05		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	T/X	4.8544E-06		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	E/X	0.4815534		0.0001										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	(B+T)/(E+X)	0.00035714		0.0000										
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	1,2,3-Trimethylbenzene	1950	ug/mL	0.2557	-0.2557	-0.0107	#DIV/0!	#DIV/0!	#DIV/0!	0.1944	0.0081	1.81	0.0236	2.34
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	1,2,4-Trimethylbenzene	7570	ug/mL	0.9927	0.0173	0.0007	0.07	0.0007	0.07	-0.1759	-0.0074	-0.90	-0.0082	-0.82
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	1,3,5-Trimethylbenzene	4210	ug/mL	0.5521	-0.1321	-0.0055	-1.31	-0.0114	-1.15	-0.4302	-0.0180	-14.76	-0.0632	-6.52
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Total TMBs	13730	ug/mL	1.8004	-0.3704	-0.0155	-1.08	-0.0096	-0.97	-0.4118	-0.0172	-1.24	-0.0109	-1.09
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Naphthalene	1050	ug/mL	0.1377	0.3623	0.0151	3.03	0.0539	5.25	0.1366	0.0057	2.08	0.0288	2.84
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	1-MethylNaphthalene	2150	ug/mL	0.2819	0.4981	0.0208	2.67	0.0425	4.17	-0.2458	-0.0103	-28.41	-0.0859	-8.96
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	2-MethylNaphthalene	3950	ug/mL	0.5180	0.0420	0.0018	0.31	0.0033	0.33	-0.3596	-0.0150	-9.49	-0.0495	-5.08
NRMRL	JP-4	10/1/73	8/27/97	EAKMW306-FP	Total Naphthalenes	7150	ug/mL	0.9376	0.9024	0.0377	2.05	0.0282	2.78	-0.4688	-0.0196	-4.18	-0.0290	-2.94

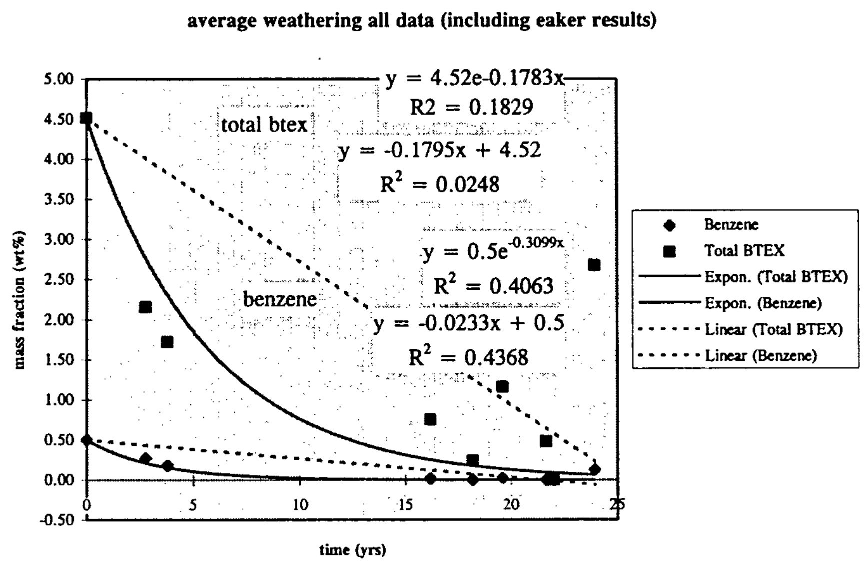
Lab	Fuel	Spill	Sample						Smith et al., 1981					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	-k	%Red./yr
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Density	0.8512	g/mL	0.0001										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Benzene	0.025	ug/mL	0.0000	0.5000	0.0224	4.48	0.5398	41.71	0.5112	0.0229	4.48	0.5408	41.77
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Toluene	0.025	ug/mL	0.0000	1.3300	0.0596	4.48	0.5836	44.21	1.7207	0.0771	4.48	0.5952	44.85
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Ethylbenzene	0.025	ug/mL	0.0000	0.3700	0.0166	4.48	0.5263	40.92	0.7569	0.0339	4.48	0.5583	42.78
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	m-Xylene	0.025	ug/mL	0.0000	0.9600	0.0430	4.48	0.5690	43.39	0.0000	0.0000	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	o-Xylene	0.025	ug/mL	0.0000	1.0100	0.0453	4.48	0.5713	43.52	0.6272	0.0281	4.48	0.5499	42.30
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	p-Xylene	0.025	ug/mL	0.0000	0.3500	0.0157	4.48	0.5238	40.77	1.7332	0.0777	4.48	0.5955	44.87
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	m,p-xylenes	0.05	ug/mL	0.0000	1.3100	0.0587	4.48	0.5519	42.41	1.7332	0.0777	4.48	0.5644	43.13
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Total Xylenes (m,p, and o)	0.075	ug/mL	0.0000	2.3200	0.1040	4.48	0.5593	42.84	2.3603	0.1058	4.48	0.5601	42.88
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Total BTEX	0.15	ug/mL	0.0000	4.5200	0.2026	4.48	0.5581	42.77	5.3491	0.2397	4.48	0.5657	43.20
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	B+T	0.05	ug/mL	0.0000										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	E+X	0.1	ug/mL	0.0000										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	B/T	1		0.0001										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	B/E	1		0.0001										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	B/X	0.333333333		0.0000										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	T/E	1		0.0001										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	T/X	0.333333333		0.0000										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	E/X	0.333333333		0.0000										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	(B+T)/(E+X)	0.5		0.0001										
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	1,2,3-Trimethylbenzene	55.6	ug/mL	0.0065	-0.0065	-0.0003	#DIV/0!	#DIV/0!	#DIV/0!	0.4436	0.0199	4.42	0.1897	17.28
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	1,2,4-Trimethylbenzene	44.4	ug/mL	0.0052	1.0048	0.0450	4.46	0.2360	21.02	0.8115	0.0364	4.45	0.2265	20.27
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	1,3,5-Trimethylbenzene	4.37	ug/mL	0.0005	0.4195	0.0188	4.48	0.3006	25.96	0.1213	0.0054	4.46	0.2451	21.74
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Total TMBs	104.37	ug/mL	0.0123	1.4177	0.0635	4.44	0.2133	19.21	1.3764	0.0617	4.44	0.2119	19.10
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Naphthalene	0.025	ug/mL	0.0000	0.5000	0.0224	4.48	0.5398	41.71	0.2743	0.0123	4.48	0.5129	40.12
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	1-MethylNaphthalene	132	ug/mL	0.0155	0.7645	0.0343	4.39	0.1756	16.10	0.0207	0.0009	2.56	0.0379	3.72
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	2-MethylNaphthalene	122	ug/mL	0.0143	0.5457	0.0245	4.37	0.1643	15.15	0.1440	0.0065	4.08	0.1077	10.21
NRMRL	JP-4	6/1/75	9/18/97	WA-CR02	Total Naphthalenes	254.025	ug/mL	0.0298	1.8102	0.0811	4.41	0.1847	16.86	0.4390	0.0197	4.20	0.1234	11.61

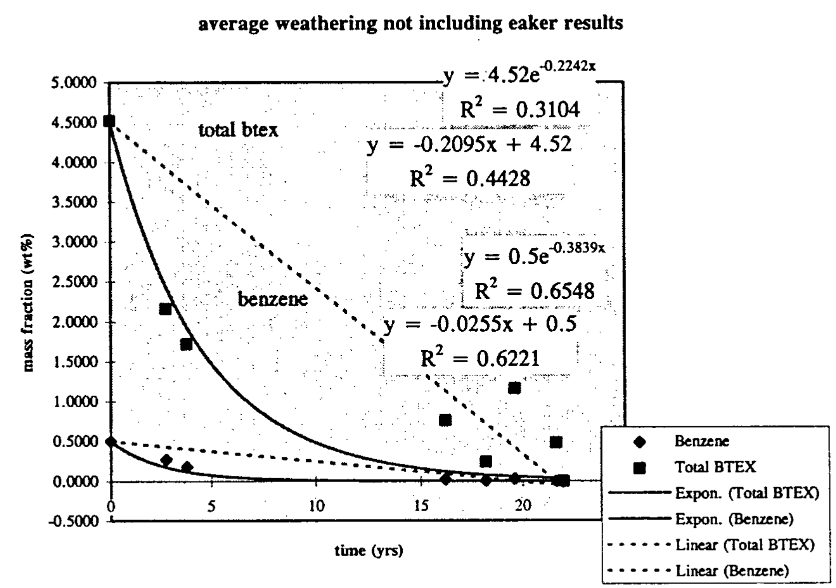
TOTAL BTEX WEATHERING AT JP-4 SITES

Data for comb_plot

	First Order Total BTEX			First Order Benzene		
	y = 4.52e ^ -0.1783x		Percent Reduction	y = 0.5e ^ -0.3099x		Percent Reduction
	Co	k1	per Year	Co	k1	per Year
	4.52	0.2242	20.08	0.5	0.3839	31.88
	4.52	0.1783	16.33	0.5	0.3099	26.65

Time	Benzene	Total BTEX	Data Source
0	0.5000	4.52	Smith et al., 1981
2.76	0.2723	2.16	Average Shaw 1997 Data
3.78	0.1798	1.72	Average Shaw 1998 Data
16.18	0.0177	0.76	Average Myrtle Beach 1997 Data
18.18	0.0013	0.24	DFSP-Charleston EW6 (1993)
19.59	0.027	1.16	DFSP-Charleston WQ27B (1995)
21.64	0.0000	0.4783	Average DFSP-Charleston 1997 Data
22.00	0.0000	0.00	McChord AFB 1997 Data
23.92	0.1256	2.6727	Average Eaker 1997 Data





s:es\remed\bioplume\weather\dataeval\JP-4_FP2.xls\3JP-4eval

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-4 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

Linear (Zero Order) Assumption

linear equation $C = C_o - kt$

summary statistics presented as follows

analyte	
k	C_o
sek	seC_o
r^2	seC
F stat.	df
ss_{regr}	ss_{resid}

k = zero order weathering rate; k = dC/dt or slope
sek = slope standard error value
Co = intercept or initial analyte concentration as calculated by regression analysis
seCo = standard error value for the constant C_o
r^2 = coefficient of determination
seC = standard error value of the estimated concentration C (i.e., a "standard deviation" for the regression line)
F stat. = F statistic or F-observed value
df = degrees of freedom
ss_{regr} = the regression sum of squares
ss_{resid} = the residual sum of squares

Exponential (1st Order) Assumption

exponential equation $C = C_o e^{-kt}$

summary statistics presented as follows

analyte	
m	C_o
sek	seC_o
r^2	seC
F stat.	df
ss_{regr}	ss_{resid}
	$\ln C_o$

m = coefficient for statistics equation shown; note $m = e^{-kt}$, therefore, ln m = -k
sek = standard error value for the exponential rate constant k
Co = intercept or initial analyte concentration as calculated by regression analysis
seCo = standard error value for the constant C_o; compare to $\ln C_o$
r^2 = coefficient of determination
seC = standard error value of the estimated concentration C (i.e., a "standard deviation" for the regression line)
F stat. = F statistic or F-observed value
df = degrees of freedom
ss_{regr} = the regression sum of squares
ss_{resid} = the residual sum of squares
$\ln C_o$ = natural log of Co for comparing to seCo

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-4 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

SHAW AFB, BLDG 1610

Evergreen Analytical Data

Sample Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	o-Xylene	m,p-Xylenes	Total Xylenes	Total BTEX
SHMW1610-2	6/1/94	0.00	0.50	1.33	0.37	1.01	1.31	2.32	4.52
	3/6/97	2.76	0.35	0.75	0.23	0.46	0.98	1.44	2.76
	3/11/98	3.78	0.17	0.38	0.18	0.40	0.76	1.15	1.88
linear									
Co			0.5151	1.3487	0.3701	0.9924	1.3224	2.3148	4.5487
Predicted C - latest sample date			0.2078	0.4356	0.1798	0.3494	0.7902	1.1395	1.9628
linear rate constant (k) (slope)			0.0813	0.2417	0.0504	0.1702	0.1409	0.3111	0.6844
average yearly reduction (%)			15.79	17.92	13.61	17.15	10.65	13.44	15.05

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0813	0.5151	-0.2417	1.3487	-0.0504	0.3701	-0.3111	2.3148	-0.6844	4.5487
0.0258	0.0696	0.0320	0.0864	0.0002	0.0006	0.0090	0.0242	0.0490	0.1323
0.9089	0.0712	0.9828	0.0884	1.0000	0.0006	0.9992	0.0248	0.9949	0.1354
10	1	57	1	52761	1	1203	1	195	1
0.0506	0.0051	0.4467	0.0078	0.0194	0.0000	0.7400	0.0006	3.5827	0.0183

exponential	Benzene	Toluene	Ethylbenzene	o-Xylene	m,p-Xylenes	Total Xylenes	Total BTEX
Co	0.5378	1.4066	0.3737	0.9912	1.3344	2.3320	4.6331
exponential rate constant (k)	0.2575	0.3028	0.1869	0.2554	0.1369	0.1825	0.2202
% reduction/year	22.70	26.13	17.05	22.54	12.80	16.68	19.77

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.7730	0.5378	0.7387	1.4066	0.8295	0.3737	0.8332	2.3320	0.8023	4.6331
0.1246	0.3368	0.0957	0.2585	0.0171	0.0461	0.0088	0.0238	0.0422	0.1141
0.8102	0.3446	0.9093	0.2645	0.9917	0.0472	0.9977	0.0243	0.9646	0.1168
4	1	10	1	120	1	430	1	27	1
0.5069	0.1187	0.7012	0.0700	0.2672	0.0022	0.2548	0.0006	0.3710	0.0136
	-0.6202		0.3412		-0.9843		0.8467		1.5332

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-4 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

SHAW AFB, BLDG 1610 (continued)
NRMRL Data

Sample Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	m-Xylen	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
SHMW1610-2	6/1/94	0.00	0.50	1.33	0.37	0.96	1.01	0.35	1.31	2.32	4.52
	3/6/97	2.76	0.29	0.64	0.18	0.54	0.39	0.19	0.73	1.12	2.22
	3/11/98	3.78	0.16	0.36	0.13	0.44	0.31	0.17	0.61	0.92	1.58
linear											
Co			0.5071	1.3328	0.3664	0.9535	0.9911	0.3452	1.2987	2.2898	4.4961
Predicted C - latest sample date			0.1797	0.3705	0.1235	0.4232	0.2600	0.1549	0.5782	0.8381	1.5118
linear rate constant (k) (slope)			0.0867	0.2547	0.0643	0.1403	0.1935	0.0504	0.1907	0.3842	0.7899
average yearly reduction (%)			17.09	19.11	17.55	14.72	19.53	14.59	14.68	16.78	17.57

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0867	0.5071	-0.2547	1.3328	-0.0643	0.3664	-0.3842	2.2898	-0.7899	4.4961
0.0122	0.0329	0.0048	0.0130	0.0062	0.0167	0.0516	0.1395	0.0408	0.1103
0.9806	0.0337	0.9996	0.0133	0.9908	0.0171	0.9823	0.1427	0.9973	0.1128
51	1	2795	1	108	1	55	1	375	1
0.0574	0.0011	0.4962	0.0002	0.0316	0.0003	1.1291	0.0204	4.7718	0.0127

exponential	Benzene	Toluene	Ethylbenzene	m-Xylen	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
Co	0.5258	1.3792	0.3699	0.9594	0.9929	0.3452	1.3045	2.2983	4.5663
exponential rate constant (k)	0.2781	0.3272	0.2702	0.2062	0.3191	0.2007	0.2047	0.2490	0.2741
% reduction/year	24.28	27.91	23.68	18.63	27.32	18.18	18.51	22.04	23.97

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.7572	0.5258	0.7209	1.3792	0.7632	0.3699	0.7796	2.2983	0.7603	4.5663
0.0861	0.2327	0.0621	0.1679	0.0003	0.0008	0.0161	0.0434	0.0174	0.0471
0.9125	0.2381	0.9652	0.1718	1.0000	0.0008	0.9959	0.0444	0.9960	0.0482
10	1	28	1	926703	1	240	1	247	1
0.5916	0.0567	0.8188	0.0295	0.5585	0.0000	0.4741	0.0020	0.5744	0.0023
	-0.6428		0.3215		-0.9944		0.8322		1.5187

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-4 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

SHAW AFB, BLDG 1610 (continued)
NRMRL Data (cont.)

Sample Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	m-Xylen	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
SHMW1610-3	6/1/94	0.00	0.50	1.33	0.37	0.96	1.01	0.35	1.31	2.32	4.52
	3/6/97	2.76	0.18	0.32	0.12	0.41	0.31	0.15	0.57	0.87	1.49
	3/11/98	3.78	0.21	0.42	0.14	0.45	0.32	0.17	0.61	0.93	1.70
linear											
Co			0.4811	1.2722	0.3565	0.9315	0.9772	0.3394	1.2709	2.2482	4.3580
Predicted C - latest sample date			0.1608	0.2659	0.1010	0.3690	0.2259	0.1372	0.5061	0.7320	1.2597
linear rate constant (k) (slope)			0.0848	0.2664	0.0676	0.1489	0.1989	0.0535	0.2024	0.4013	0.8201
average yearly reduction (%)			17.62	20.94	18.97	15.99	20.35	15.77	15.93	17.85	18.82

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0848	0.4811	-0.2664	1.2722	-0.0676	0.3565	-0.4013	2.2482	-0.8201	4.3580
0.0323	0.0873	0.0987	0.2668	0.0230	0.0622	0.1228	0.3318	0.2768	0.7481
0.8732	0.0894	0.8792	0.2730	0.8964	0.0636	0.9144	0.3395	0.8977	0.7654
7	1	7	1	9	1	11	1	9	1
0.0550	0.0080	0.5426	0.0745	0.0350	0.0040	1.2316	0.1153	5.1434	0.5859

exponential	Benzene	Toluene	Ethylbenzene	m-Xylen	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
Co	0.4664	1.2062	0.3457	0.9159	0.9535	0.3335	1.2495	2.2033	4.2304
exponential rate constant (k)	0.2584	0.3476	0.2927	0.2240	0.3344	0.2194	0.2228	0.2661	0.2889
% reduction/year	22.77	29.36	25.38	20.07	28.43	19.70	19.97	23.37	25.09

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.7723	0.4664	0.7064	1.2062	0.7462	0.3457	0.7663	2.2033	0.7491	4.2304
0.1187	0.3208	0.1670	0.4513	0.1163	0.3143	0.0882	0.2383	0.1131	0.3058
0.8258	0.3282	0.8125	0.4617	0.8637	0.3216	0.9011	0.2439	0.8670	0.3129
5	1	4	1	6	1	9	1	7	1
0.5107	0.1077	0.9241	0.2132	0.6553	0.1034	0.5417	0.0595	0.6382	0.0979
	-0.7626		0.1875		-1.0623		0.7900		1.4423

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-4 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

DFSP-Charleston, Tank 1
NRMRL Data

Sample Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	m-Xylen	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
EW-6	10/1/75	0.00	0.50	1.33	0.37	0.96	1.01	0.35	1.31	2.32	4.52
	12/1/93	18.18	0.0013	0.0057	0.0478	0.1328	0.0115	0.0428	0.1756	0.1871	0.2419
	5/17/97	21.64	0.0000	0.0002	0.0115	0.0276	0.0027	0.0138	0.0415	0.0441	0.0558
linear											
Co			0.4927	1.3109	0.3681	0.9559	0.9959	0.3477	1.3037	2.2996	4.4713
Predicted C - latest sample date			-0.0382	-0.1003	0.0013	0.0063	-0.0712	0.0018	0.0081	-0.0631	-0.2003
linear rate constant (k) (slope)			0.0245	0.0652	0.0169	0.0439	0.0493	0.0160	0.0599	0.1092	0.2159
average yearly reduction (%)			4.98	4.97	4.60	4.59	4.95	4.60	4.59	4.75	4.83

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0245	0.4927	-0.0652	1.3109	-0.0169	0.3681	-0.1092	2.2996	-0.2159	4.4713
0.0036	0.0593	0.0096	0.1562	0.0010	0.0159	0.0102	0.1666	0.0244	0.3981
0.9785	0.0598	0.9789	0.1574	0.9967	0.0160	0.9913	0.1679	0.9874	0.4010
46	1	46	1	304	1	114	1	78	1
0.1627	0.0036	1.1493	0.0248	0.0776	0.0003	3.2216	0.0282	12.5946	0.1608

exponential	Benzene	Toluene	Ethylbenzene	m-Xylen	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
Co	0.7310	1.6114	0.4010	1.0531	1.0589	0.3704	1.4224	2.5005	4.8507
exponential rate constant (k)	0.4788	0.3766	0.1447	0.1457	0.2651	0.1382	0.1434	0.1684	0.1892
% reduction/year	38.05	31.38	13.47	13.56	23.29	12.91	13.36	15.50	17.24

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.6195	0.7310	0.6862	1.6114	0.8653	0.4010	0.8450	2.5005	0.8276	4.8507
0.1901	3.1026	0.0961	1.5678	0.0403	0.6575	0.0375	0.6119	0.0353	0.5767
0.8638	3.1258	0.9389	1.5795	0.9280	0.6624	0.9527	0.6165	0.9663	0.5811
6	1	15	1	13	1	20	1	29	1
61.9656	9.7706	38.3405	2.4947	5.6589	0.4387	7.6621	0.3801	9.6766	0.3376
	-0.3133		0.4771		-0.9138		0.9165		1.5791

									Beaufort MCAS Fresh JP-5					Hughes et al., 1984				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	$C_o - C$	k	%Red./yr	k	%Red./yr	$C_o - C$	k	%Red./yr	k	%Red./yr
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	Benzene	2230	ug/L	0.0003	-0.0001	0.0000	-6.13	-0.0508	-5.21	-0.0003	0.0000	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	Toluene	20000	ug/L	0.0025	0.0022	0.0003	6.49	0.0874	8.37	-0.0025	-0.0003	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	Ethylbenzene	160000	ug/L	0.0199	0.0220	0.0031	7.30	0.1035	9.83	-0.0199	-0.0028	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	o-Xylene	330000	ug/L	0.0410	0.0600	0.0083	8.25	0.1251	11.76	-0.0209	-0.0029	-14.43	-0.0989	-10.40
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	m,p-Xylene	680000	ug/L	0.0845	0.0538	0.0075	5.40	0.0684	6.61	-0.0845	-0.0117	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	Total Xylenes (m,p, and o)	1010000	ug/L	0.1256	0.1138	0.0158	6.60	0.0896	8.57	-0.1054	-0.0146	-72.76	-0.2542	-28.95
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	Total BTEX	1192230	ug/L	0.1482	0.1379	0.0191	6.69	0.0913	8.73	-0.1281	-0.0178	-88.40	-0.2773	-31.95
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	B+T	22230	ug/L	0.0028										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	E+X	1170000	ug/L	0.1455										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	B/T	0.1115		0.0000										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	B/E	0.0139375		0.0000										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	B/X	0.00220792		0.0000										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	T/E	0.125		0.0000										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	T/X	0.01980198		0.0000										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	E/X	0.15841584		0.0000										
EAL	JP-5	6/1/90	8/12/97	BFT-401-3	(B+T)/(E+X)	0.019		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	Benzene	1500	ug/L	0.0002	0.0000	0.0000	0.00	0.0000	0.00	-0.0002	0.0000	#DIV/0!	1.1314	67.74
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	Toluene	36000	ug/L	0.0046	0.0001	0.0000	0.16	0.0016	0.16	-0.0046	-0.0007	#DIV/0!	0.8495	57.24
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	Ethylbenzene	370000	ug/L	0.0474	-0.0055	-0.0008	-1.89	-0.0177	-1.79	-0.0474	-0.0068	#DIV/0!	0.3974	32.79
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	Total Xylenes (m,p, and o)	2600000	ug/L	0.3333	-0.0940	-0.0135	-5.63	-0.0475	-4.87	-0.3132	-0.0449	-223.37	0.2808	24.49
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	Total BTEX	3007500	ug/L	0.3856	-0.0994	-0.0143	-4.93	-0.0428	-4.37	-0.3655	-0.0524	-260.63	0.3773	31.43
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	B+T	37500	ug/L	0.0048										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	E+X	2970000	ug/L	0.3808										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	B/T	0.04166667		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	B/E	0.00405405		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	B/X	0.00057692		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	T/E	0.0972973		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	T/X	0.01384615		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	E/X	0.14230769		0.0000										
EAL	JP-5	6/1/90	5/19/97	Fresh JP-5	(B+T)/(E+X)	0.01262626		0.0000										

Lab Code	Fuel Type	Spill Date	Sample Date	Locid	Analyte	Results	Units	Mass Fraction	Beaufort MCAS Fresh JP-5 C_o - C	Beaufort Linear k	Beaufort Linear %Red./yr	Beaufort Exponential k	Beaufort Exponential %Red./yr	Hughes et al., 1984 C_o - C	Hughes Linear k	Hughes Linear %Red./yr	Hughes Exponential k	Hughes Exponential %Red./yr
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Density	0.8044	g/mL	0.0001										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Benzene	2.23	ug/mL	0.0003	-0.0001	0.0000	-6.13	-0.0508	-5.21	-0.0003	0.0000	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Toluene	13	ug/mL	0.0016	0.0031	0.0004	9.08	0.1472	13.69	-0.0016	-0.0002	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Ethylbenzene	116	ug/mL	0.0144	0.0275	0.0038	9.11	0.1482	13.77	-0.0144	-0.0020	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	m-Xylene	224	ug/mL	0.0278	0.0698	0.0097	9.93	0.1743	15.99	-0.0278	-0.0039	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	o-Xylene	287	ug/mL	0.0357	0.0653	0.0091	8.98	0.1445	13.45	-0.0156	-0.0022	-10.74	-0.0795	-8.28
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	p-Xylene	99.6	ug/mL	0.0124	0.0283	0.0039	9.65	0.1650	15.21	-0.0124	-0.0017	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	m,p-xylenes	323.6	ug/mL	0.0402	0.0981	0.0136	9.85	0.1715	15.76	-0.0402	-0.0056	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Total Xylenes (m,p, and o)	610.6	ug/mL	0.0759	0.1635	0.0227	9.48	0.1594	14.74	-0.0558	-0.0077	-38.50	-0.1844	-20.24
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Total BTEX	741.83	ug/mL	0.0922	0.1939	0.0269	9.41	0.1572	14.55	-0.0721	-0.0100	-49.76	-0.2114	-23.54
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	B+T	15.23	ug/mL	0.0019										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	E+X	726.6	ug/mL	0.0903										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	B/T	0.17153846		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	B/E	0.01922414		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	B/X	0.00365215		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	T/E	0.11206897		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	T/X	0.02129053		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	E/X	0.18997707		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	(B+T)/(E+X)	0.02096064		0.0000										
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	1,2,3-Trimethylbenzene	1700	ug/mL	0.2113	0.0951	0.0132	4.31	0.0516	5.03	0.3555	0.0494	8.71	0.1370	12.80
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	1,2,4-Trimethylbenzene	2060	ug/mL	0.2561	0.2785	0.0387	7.23	0.1022	9.71	0.2457	0.0341	6.80	0.0934	8.92
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	1,3,5-Trimethylbenzene	856	ug/mL	0.1064	0.0346	0.0048	3.41	0.0391	3.83	0.0380	0.0053	3.65	0.0424	4.15
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Total TMBs	4616	ug/mL	0.5738	0.4082	0.0567	5.77	0.0746	7.19	0.6392	0.0887	7.32	0.1039	9.87
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Naphthalene	455	ug/mL	0.0566	0.0637	0.0088	7.35	0.1047	9.94	0.8298	0.1152	13.00	0.3820	31.75
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	1-MethylNaphthalene	1290	ug/mL	0.1604	0.0666	0.0092	4.07	0.0482	4.71	0.1059	0.0147	5.52	0.0704	6.80
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	2-MethylNaphthalene	1500	ug/mL	0.1865	0.1084	0.0150	5.10	0.0636	6.16	0.2656	0.0369	8.16	0.1229	11.57
NRMRL	JP-5	6/1/90	8/12/97	BFT-401-3	Total Naphthalenes	3245	ug/mL	0.4034	0.2386	0.0331	5.16	0.0645	6.25	1.2013	0.1668	10.39	0.1917	17.44
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Density	0.78	g/mL	0.0001										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Benzene	1.5	ug/mL	0.0002	0.0000	0.0000	0.00	0.0000	0.00	-0.0002	0.0000	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Toluene	36.4	ug/mL	0.0047	0.0000	0.0000	0.00	0.0000	0.00	-0.0047	-0.0007	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Ethylbenzene	327	ug/mL	0.0419	0.0000	0.0000	0.00	0.0000	0.00	-0.0419	-0.0060	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	m-Xylene	762	ug/mL	0.0977	0.0000	0.0000	0.00	0.0000	0.00	-0.0977	-0.0140	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	o-Xylene	788	ug/mL	0.1010	0.0000	0.0000	0.00	0.0000	0.00	-0.0809	-0.0116	-57.70	-0.2315	-26.05
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	p-Xylene	317	ug/mL	0.0406	0.0000	0.0000	0.00	0.0000	0.00	-0.0406	-0.0058	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	m,p-xylenes	1079	ug/mL	0.1383	0.0000	0.0000	0.00	0.0000	0.00	-0.1383	-0.0198	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Total Xylenes (m,p, and o)	1867	ug/mL	0.2394	0.0000	0.0000	0.00	0.0000	0.00	-0.2192	-0.0315	-156.35	-0.3553	-42.66
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Total BTEX	2231.9	ug/mL	0.2861	0.0000	0.0000	0.00	0.0000	0.00	-0.2660	-0.0382	-189.72	-0.3809	-46.36
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	B+T	37.9	ug/mL	0.0049										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	E+X	2194	ug/mL	0.2813										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	B/T	0.04120879		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	B/E	0.00458716		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	B/X	0.00080343		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	T/E	0.11131498		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	T/X	0.01949652		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	E/X	0.1751473		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	(B+T)/(E+X)	0.01727438		0.0000										
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	1,2,3-Trimethylbenzene	2390	ug/mL	0.3064	0.0000	0.0000	0.00	0.0000	0.00	0.2605	0.0374	6.59	0.0883	8.45
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	1,2,4-Trimethylbenzene	4170	ug/mL	0.5346	0.0000	0.0000	0.00	0.0000	0.00	-0.0328	-0.0047	-0.94	-0.0091	-0.91
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	1,3,5-Trimethylbenzene	1100	ug/mL	0.1410	0.0000	0.0000	0.00	0.0000	0.00	0.0034	0.0005	0.33	0.0034	0.34
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Total TMBs	7660	ug/mL	0.9821	0.0000	0.0000	0.00	0.0000	0.00	0.2310	0.0331	2.73	0.0303	2.99
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Naphthalene	938	ug/mL	0.1203	0.0000	0.0000	0.00	0.0000	0.00	0.7661	0.1099	12.40	0.2866	24.92
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	1-MethylNaphthalene	1770	ug/mL	0.2269	0.0000	0.0000	0.00	0.0000	0.00	0.0393	0.0056	2.12	0.0229	2.27
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	2-MethylNaphthalene	2300	ug/mL	0.2949	0.0000	0.0000	0.00	0.0000	0.00	0.1572	0.0226	4.99	0.0613	5.95
NRMRL	JP-5	6/1/90	5/19/97	Fresh JP-5	Total Naphthalenes	5008	ug/mL	0.6421	0.0000	0.0000	0.00	0.0000	0.00	0.9627	0.1381	8.61	0.1314	12.32

Lab	Fuel	Spill	Sample						Beaufort MCAS Fresh JP-5					Hughes et al., 1984				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Benzene	23500	ug/L	0.002941176	-0.0027	-0.0002	-89.46	-0.1707	-18.61	-0.0029	-0.0002	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Toluene	122000	ug/L	0.015269086	-0.0106	-0.0007	-14.22	-0.0742	-7.70	-0.0153	-0.0010	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Ethylbenzene	3200000	ug/L	0.400500626	-0.3586	-0.0224	-53.53	-0.1412	-15.17	-0.4005	-0.0251	#DIV/0!	#DIV/0!	#DIV/0!
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Total Xylenes (m,p, and o)	7300000	ug/L	0.913642053	-0.6743	-0.0422	-17.63	-0.0838	-8.74	-0.8935	-0.0559	-277.96	-0.2388	-26.97
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Total BTEX	10645500	ug/L	1.332352941	-1.0462	-0.0655	-22.88	-0.0963	-10.11	-1.3122	-0.0821	-408.22	-0.2624	-30.01
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B+T	145500	ug/L	0.018210263										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	E+X	10500000	ug/L	1.314142678										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B/T	0.19262295		2.4108E-08										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B/E	0.00734375		9.19118E-10										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B/X	0.00321918		4.02901E-10										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	T/E	0.038125		4.77159E-09										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	T/X	0.01671233		2.09166E-09										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	E/X	0.43835616		5.48631E-08										
EAL	JP-5	6/1/81	5/20/97	CEF-293-9FP	(B+T)/(E+X)	0.01385714		1.73431E-09										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Density	0.799	g/mL	0.0001										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Benzene	23.5	ug/mL	0.002941176	-0.0027	-0.0002	-89.46	-0.1707	-18.61	-0.0029	-0.0002	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Toluene	122	ug/mL	0.015269086	-0.0106	-0.0007	-14.22	-0.0742	-7.70	-0.0153	-0.0010	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Ethylbenzene	2520	ug/mL	0.315394243	-0.2735	-0.0171	-40.83	-0.1263	-13.46	-0.3154	-0.0197	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	m-Xylene	2800	ug/mL	0.350438048	-0.2527	-0.0158	-16.19	-0.0799	-8.32	-0.3504	-0.0219	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	o-Xylene	317	ug/mL	0.039674593	0.0614	0.0038	3.80	0.0585	5.68	-0.0196	-0.0012	-6.08	-0.0425	-4.34
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	p-Xylene	1670	ug/mL	0.209011264	-0.1684	-0.0105	-25.93	-0.1025	-10.79	-0.2090	-0.0131	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	m,p-xylenes	4470	ug/mL	0.5594	-0.4211	-0.0264	-19.05	-0.0875	-9.14	-0.5594	-0.0350	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Total Xylenes (m,p, and o)	4787	ug/mL	0.599123905	-0.3598	-0.0225	-9.41	-0.0574	-5.91	-0.5790	-0.0362	-180.12	-0.2124	-23.66
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Total BTEX	7452.5	ug/mL	0.932728411	-0.6466	-0.0405	-14.14	-0.0740	-7.68	-0.9126	-0.0571	-283.90	-0.2401	-27.14
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B+T	145.5	ug/mL	0.018210263										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	E+X	7307	ug/mL	0.914518148										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B/T	0.19262295		2.4108E-05										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B/E	0.0093254		1.16713E-06										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	B/X	0.00490913		6.14409E-07										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	T/E	0.0484127		6.05916E-06										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	T/X	0.02548569		3.1897E-06										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	E/X	0.52642574		6.58856E-05										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	(B+T)/(E+X)	0.01991241		2.49217E-06										
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	1,2,3-Trimethylbenzene	1860	ug/mL	0.232790989	0.0736	0.0046	1.50	0.0172	1.71	0.3341	0.0209	3.69	0.0557	5.42
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	1,2,4-Trimethylbenzene	4000	ug/mL	0.500625782	0.0340	0.0021	0.40	0.0041	0.41	0.0011	0.0001	0.01	0.0001	0.01
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	1,3,5-Trimethylbenzene	1400	ug/mL	0.175219024	-0.0342	-0.0021	-1.52	-0.0136	-1.37	-0.0308	-0.0019	-1.34	-0.0121	-1.22
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Total TMBs	7260	ug/mL	0.9086	0.0734	0.0046	0.47	0.0049	0.49	0.3044	0.0190	1.57	0.0181	1.79
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Naphthalene	1880	ug/mL	0.235294118	-0.1150	-0.0072	-5.99	-0.0420	-4.29	0.6511	0.0407	4.60	0.0830	7.97
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	1-MethylNaphthalene	2290	ug/mL	0.28660826	-0.0597	-0.0037	-1.65	-0.0146	-1.47	-0.0203	-0.0013	-0.48	-0.0046	-0.46
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	2-MethylNaphthalene	3320	ug/mL	0.415519399	-0.1206	-0.0076	-2.56	-0.0215	-2.17	0.0366	0.0023	0.51	0.0053	0.53
NRMRL	JP-5	6/1/81	5/20/97	CEF-293-9FP	Total Naphthalenes	7490	ug/mL	0.9374	-0.2954	-0.0185	-2.88	-0.0237	-2.40	0.6673	0.0418	2.60	0.0336	3.31

Lab	Fuel	Spill	Sample						Smith et al., 1981					Mayfield, 1996				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./y	C_o - C	k	%Red./y	k	%Red./yr
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	Density	0.793	g/mL	0.0001										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	Benzene	0.025	ug/mL	0.0000	0.0000	0.0000	#DIV/0!	#DIV/0!	#DIV/0!	0.0321	0.1096	341.09	31.4846	100.00
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	Toluene	0.025	ug/mL	0.0000	0.0000	0.0000	#DIV/0!	#DIV/0!	#DIV/0!	0.2083	0.7107	341.12	37.8600	100.00
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	Ethylbenzene	63	ug/mL	0.0079	-0.0079	-0.0271	#DIV/0!	#DIV/0!	#DIV/0!	0.1432	0.4886	323.20	10.0496	100.00
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	m-Xylene	441	ug/mL	0.0556	0.0044	0.0150	24.95	0.2591	22.82	-0.0556	-0.1897	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	o-Xylene	453	ug/mL	0.0571	0.0029	0.0098	16.35	0.1675	15.42	0.3536	1.2062	293.68	6.7292	99.88
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	p-Xylene	111	ug/mL	0.0140	-0.0140	-0.0477	#DIV/0!	#DIV/0!	#DIV/0!	-0.0140	-0.0477	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	m,p-xylenes	552	ug/mL	0.0696	-0.0096	-0.0328	-54.63	-0.5067	-65.99	0.6506	2.2194	308.15	7.9709	99.97
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	Total Xylenes (m,p, and o)	1005	ug/mL	0.1267	-0.0067	-0.0230	-19.14	-0.1862	-20.47	1.0042	3.4256	302.90	7.4662	99.94
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	Total BTEX	1068.05	ug/mL	0.1347	-0.0147	-0.0501	-41.74	-0.3938	-48.26	1.3879	4.7345	310.95	8.2731	99.97
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	B+T	0.05	ug/mL	0.0000										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	E+X	1068	ug/mL	0.1347										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	B/T	1		0.0001										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	B/E	0.000396825		0.0000										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	B/X	2.48756E-05		0.0000										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	T/E	0.000396825		0.0000										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	T/X	2.48756E-05		0.0000										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	E/X	0.062686567		0.0000										
NRMRL	JP-8	4/1/96	7/17/96	SOURCE AREA	(B+T)/(E+X)	4.68165E-05		0.0000										

									Smith et al., 1981					Mayfield, 1996				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	$C_o - C$	k	%Red./yr	k	%Red./y	$C_o - C$	k	%Red./y	k	%Red./yr
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Benzene	50000	ug/L	0.0061	-0.0061	-0.0027	#DIV/0!	#DIV/0!	#DIV/0!	0.0260	0.0114	35.61	0.7299	51.81
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Toluene	630000	ug/L	0.0770	-0.0770	-0.0339	#DIV/0!	#DIV/0!	#DIV/0!	0.1313	0.0577	27.72	0.4376	35.44
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Ethylbenzene	1100000	ug/L	0.1345	-0.1345	-0.0591	#DIV/0!	#DIV/0!	#DIV/0!	0.0167	0.0074	4.86	0.0515	5.02
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	o-Xylene	1400000	ug/L	0.1711	-0.1111	-0.0489	-81.46	-0.4610	-58.56	0.2396	0.1054	25.65	0.3849	31.95
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	m,p-Xylene	3100000	ug/L	0.3790	-0.3190	-0.1403	-233.79	-0.8105	-124.91	0.3413	0.1501	20.84	0.2824	24.60
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Total Xylenes (m,p, and o)	4500000	ug/L	0.5501	-0.4301	-0.1892	-157.63	-0.6696	-95.35	0.5808	0.2554	22.58	0.3169	27.16
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Total BTEX	6280000	ug/L	0.7677	-0.6477	-0.2848	-237.37	-0.8162	-126.18	0.7549	0.3320	21.80	0.3011	26.00
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B+T	680000	ug/L	0.0831										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	E+X	5600000	ug/L	0.6846										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B/T	0.079365079		0.0000										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B/E	0.045454545		0.0000										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B/X	0.011111111		0.0000										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	T/E	0.572727273		0.0000										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	T/X	0.14		0.0000										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	E/X	0.244444444		0.0000										
EAL	JP-8	12/1/95	3/10/98	SJ98-MW1S	(B+T)/(E+X)	0.121428571		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	Benzene	150000	ug/L	0.0189	-0.0189	-0.0130	#DIV/0!	#DIV/0!	#DIV/0!	0.0132	0.0091	28.29	0.3645	30.54
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	Toluene	1000000	ug/L	0.1261	-0.1261	-0.0867	#DIV/0!	#DIV/0!	#DIV/0!	0.0822	0.0565	27.13	0.3451	29.18
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	Ethylbenzene	790000	ug/L	0.0996	-0.0996	-0.0685	#DIV/0!	#DIV/0!	#DIV/0!	0.0516	0.0354	23.45	0.2867	24.93
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	Total Xylenes (m,p, and o)	5200000	ug/L	0.6557	-0.5357	-0.3683	-306.88	-1.1674	-221.35	0.4752	0.3267	28.88	0.3747	31.25
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	Total BTEX	7140000	ug/L	0.9004	-0.7804	-0.5364	-447.02	-1.3853	-299.60	0.6222	0.4277	28.09	0.3611	30.31
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	B+T	1150000	ug/L	0.1450										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	E+X	5990000	ug/L	0.7554										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	B/T	0.15		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	B/E	0.189873418		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	B/X	0.028846154		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	T/E	1.265822785		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	T/X	0.192307692		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	E/X	0.151923077		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW1SFP	(B+T)/(E+X)	0.191986644		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	Benzene	220000	ug/L	0.0284	-0.0284	-0.0195	#DIV/0!	#DIV/0!	#DIV/0!	0.0037	0.0026	7.95	0.0845	8.10
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	Toluene	1100000	ug/L	0.1421	-0.1421	-0.0977	#DIV/0!	#DIV/0!	#DIV/0!	0.0662	0.0455	21.85	0.2629	23.12
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	Ethylbenzene	1200000	ug/L	0.1550	-0.1550	-0.1066	#DIV/0!	#DIV/0!	#DIV/0!	-0.0038	-0.0026	-1.75	-0.0173	-1.74
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	Total Xylenes (m,p, and o)	6900000	ug/L	0.8915	-0.7715	-0.5303	-441.91	-1.3785	-296.88	0.2395	0.1646	14.56	0.1636	15.09
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	Total BTEX	9420000	ug/L	1.2171	-1.0971	-0.7541	-628.41	-1.5925	-391.58	0.3056	0.2100	13.79	0.1540	14.27
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	B+T	1320000	ug/L	0.1705										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	E+X	8100000	ug/L	1.0465										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	B/T	0.2		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	B/E	0.183333333		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	B/X	0.031884058		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	T/E	0.916666667		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	T/X	0.15942029		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	E/X	0.173913043		0.0000										
EAL	JP-8	12/1/95	5/15/97	SJMW2SFP	(B+T)/(E+X)	0.162962963		0.0000										

									Smith et al., 1981					Mayfield, 1996				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./y	C_o - C	k	%Red./y	k	%Red./yr
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Density	0.812	g/mL	0.0001										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Benzene	48.9	ug/mL	0.0060	-0.0060	-0.0026	#DIV/0!	#DIV/0!	#DIV/0!	0.0261	0.0115	35.74	0.7365	52.12
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Toluene	638	ug/mL	0.0786	-0.0786	-0.0346	#DIV/0!	#DIV/0!	#DIV/0!	0.1298	0.0571	27.39	0.4288	34.87
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Ethylbenzene	850	ug/mL	0.1047	-0.1047	-0.0460	#DIV/0!	#DIV/0!	#DIV/0!	0.0465	0.0205	13.53	0.1617	14.93
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	m-Xylene	1510	ug/mL	0.1860	-0.1260	-0.0554	-92.32	-0.4975	-64.45	-0.1860	-0.0818	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	o-Xylene	1110	ug/mL	0.1367	-0.0767	-0.0337	-56.22	-0.3621	-43.64	0.2740	0.1205	29.34	0.4838	38.36
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	p-Xylene	592	ug/mL	0.0729	-0.0729	-0.0321	#DIV/0!	#DIV/0!	#DIV/0!	-0.0729	-0.0321	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	m,p-xylenes	2102	ug/mL	0.2589	-0.1989	-0.0875	-145.76	-0.6429	-90.20	0.4614	0.2029	28.17	0.4500	36.24
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Total Xylenes (m,p, and o)	3212	ug/mL	0.3956	-0.2756	-0.1212	-100.99	-0.5246	-68.97	0.7354	0.3234	28.59	0.4620	37.00
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Total BTEX	4748.9	ug/mL	0.5848	-0.4648	-0.2044	-170.35	-0.6965	-100.67	0.9378	0.4124	27.08	0.4208	34.35
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	B+T	686.9	ug/mL	0.0846										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	E+X	4062	ug/mL	0.5002										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	B/T	0.076645768		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	B/E	0.057529412		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	B/X	0.015224159		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	T/E	0.750588235		0.0001										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	T/X	0.198630137		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	E/X	0.264632628		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	(B+T)/(E+X)	0.16910389		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	1,2,3-Trimethylbenzene	2330	ug/mL	0.2869	-0.2869	-0.1262	#DIV/0!	#DIV/0!	#DIV/0!	0.3869	0.1701	25.25	0.3754	31.30
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	1,2,4-Trimethylbenzene	4380	ug/mL	0.5394	-0.2694	-0.1185	-43.88	-0.3043	-35.57	0.9249	0.4067	27.78	0.4392	35.54
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	1,3,5-Trimethylbenzene	1150	ug/mL	0.1416	-0.1416	-0.0623	#DIV/0!	#DIV/0!	#DIV/0!	0.3667	0.1613	31.72	0.5620	42.99
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Total TMBs	7860	ug/mL	0.9680	-0.6980	-0.3069	-113.68	-0.5615	-75.33	1.6784	0.7381	27.89	0.4423	35.74
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Naphthalene	879	ug/mL	0.1083	1.0317	0.4537	39.80	1.0353	64.49	0.1465	0.0644	25.29	0.3764	31.37
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	1-MethylNaphthalene	1290	ug/mL	0.1589	1.6811	0.7393	40.18	1.0772	65.94	0.2685	0.1181	27.63	0.4352	35.29
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	2-MethylNaphthalene	1900	ug/mL	0.2340	1.2260	0.5391	36.93	0.8052	55.30	0.1208	0.0531	14.97	0.1830	16.72
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MP2	Total Naphthalenes	4069	ug/mL	0.5011	3.9389	1.7322	39.01	0.9594	61.69	0.5358	0.2356	22.72	0.3198	27.37
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Density	0.818	g/mL	0.0001										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Benzene	47.2	ug/mL	0.0058	-0.0058	-0.0025	#DIV/0!	#DIV/0!	#DIV/0!	0.0264	0.0116	36.08	0.7553	53.01
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Toluene	602	ug/mL	0.0736	-0.0736	-0.0324	#DIV/0!	#DIV/0!	#DIV/0!	0.1347	0.0593	28.44	0.4576	36.72
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Ethylbenzene	800	ug/mL	0.0978	-0.0978	-0.0430	#DIV/0!	#DIV/0!	#DIV/0!	0.0534	0.0235	15.53	0.1916	17.43
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	m-Xylene	1420	ug/mL	0.1736	-0.1136	-0.0500	-83.26	-0.4672	-59.55	-0.1736	-0.0763	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	o-Xylene	1040	ug/mL	0.1271	-0.0671	-0.0295	-49.21	-0.3302	-39.13	0.2836	0.1247	30.36	0.5157	40.29
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	p-Xylene	580	ug/mL	0.0709	-0.0709	-0.0312	#DIV/0!	#DIV/0!	#DIV/0!	-0.0709	-0.0312	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	m,p-xylenes	2000	ug/mL	0.2445	-0.1845	-0.0811	-135.23	-0.6178	-85.48	0.4757	0.2092	29.05	0.4751	37.82
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Total Xylenes (m,p, and o)	3040	ug/mL	0.3716	-0.2516	-0.1107	-92.22	-0.4971	-64.40	0.7593	0.3339	29.53	0.4894	38.70
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Total BTEX	4489.2	ug/mL	0.5488	-0.4288	-0.1886	-157.14	-0.6685	-95.14	0.9738	0.4282	28.13	0.4488	36.16
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B+T	649.2	ug/mL	0.0794										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	E+X	3840	ug/mL	0.4694										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B/T	0.078405316		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B/E	0.059		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	B/X	0.015526316		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	T/E	0.7525		0.0001										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	T/X	0.198026316		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	E/X	0.263157895		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	(B+T)/(E+X)	0.1690625		0.0000										
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	1,2,3-Trimethylbenzene	2240	ug/mL	0.2738	-0.2738	-0.1204	#DIV/0!	#DIV/0!	#DIV/0!	0.4000	0.1759	26.10	0.3960	32.70
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	1,2,4-Trimethylbenzene	4190	ug/mL	0.5122	0.0224	0.0098	1.84	0.0188	1.86	-0.0104	-0.0046	-0.92	-0.0091	-0.91
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	1,3,5-Trimethylbenzene	1090	ug/mL	0.1333	0.0078	0.0034	2.42	0.0249	2.46	0.0111	0.0049	3.39	0.0353	3.47
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Total TMBs	7520	ug/mL	0.9193	0.0627	0.0276	2.81	0.0290	2.86	0.2937	0.1292	10.65	0.1219	11.48
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Naphthalene	844	ug/mL	0.1032	0.0171	0.0075	6.25	0.0674	6.51	0.7832	0.3444	38.86	0.9458	61.16
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	1-MethylNaphthalene	1250	ug/mL	0.1528	0.0741	0.0326	14.36	0.1739	15.96	0.1135	0.0499	18.74	0.2442	21.67
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	2-MethylNaphthalene	1830	ug/mL	0.2237	0.0712	0.0313	10.61	0.1214	11.44	0.2284	0.1004	22.21	0.3094	26.61
NRMRL	JP-8	12/1/95	3/10/98	SJ98-MW1S	Total Naphthalenes	3924	ug/mL	0.4797	0.1623	0.0714	11.12	0.1282	12.03	1.1250	0.4947	30.83	0.5310	41.20

Lab	Fuel	Spill	Sample						Smith et al., 1981					Mayfield, 1996				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./y	C_o - C	k	%Red./y	k	%Red./yr
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	Density	0.793	g/mL	0.0001										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	Benzene	246	ug/mL	0.0310	-0.0310	-0.0505	#DIV/0!	#DIV/0!	#DIV/0!	0.0011	0.0018	5.68	0.0579	5.62
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	Toluene	1631	ug/mL	0.2057	-0.2057	-0.3351	#DIV/0!	#DIV/0!	#DIV/0!	0.0027	0.0043	2.08	0.0209	2.07
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	Ethylbenzene	1239	ug/mL	0.1562	-0.1562	-0.2546	#DIV/0!	#DIV/0!	#DIV/0!	-0.0051	-0.0082	-5.44	-0.0536	-5.50
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	m-Xylene	4042	ug/mL	0.5097	-0.4497	-0.7328	-1221.31	-3.4862	-3166.27	-0.5097	-0.8306	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	o-Xylene	2313	ug/mL	0.2917	-0.2317	-0.3775	-629.18	-2.5767	-1215.34	0.1190	0.1940	47.23	0.5577	42.75
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	p-Xylene	1172	ug/mL	0.1478	-0.1478	-0.2408	#DIV/0!	#DIV/0!	#DIV/0!	-0.1478	-0.2408	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	m,p-xylenes	5214	ug/mL	0.6575	-0.5975	-0.9736	-1622.68	-3.9011	-4845.72	0.0627	0.1022	14.19	0.1485	13.80
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	Total Xylenes (m,p, and o)	7527	ug/mL	0.9492	-0.8292	-1.3511	-1125.93	-3.3699	-2807.58	0.1818	0.2962	26.19	0.2855	24.84
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	Total BTEX	10643	ug/mL	1.3421	-1.2221	-1.9914	-1659.50	-3.9344	-5012.95	0.1805	0.2941	19.32	0.2056	18.58
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	B+T	1877	ug/mL	0.2367										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	E+X	8766	ug/mL	1.1054										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	B/T	0.150827713		0.0000										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	B/E	0.198547215		0.0000										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	B/X	0.032682344		0.0000										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	T/E	1.316384181		0.0002										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	T/X	0.216686595		0.0000										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	E/X	0.164607413		0.0000										
NRMRL	JP-8	12/1/95	7/12/96	SJMW1S	(B+T)/(E+X)	0.214122747		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Density	0.793	g/mL	0.0001										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Benzene	194	ug/mL	0.0245	-0.0245	-0.0168	#DIV/0!	#DIV/0!	#DIV/0!	0.0077	0.0053	16.42	0.1876	17.11
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Toluene	1030	ug/mL	0.1299	-0.1299	-0.0893	#DIV/0!	#DIV/0!	#DIV/0!	0.0784	0.0539	25.88	0.3248	27.73
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Ethylbenzene	1170	ug/mL	0.1475	-0.1475	-0.1014	#DIV/0!	#DIV/0!	#DIV/0!	0.0036	0.0025	1.66	0.0168	1.67
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	m-Xylene	3120	ug/mL	0.3934	-0.3334	-0.2292	-382.00	-1.2927	-264.26	-0.3934	-0.2704	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	o-Xylene	1760	ug/mL	0.2219	-0.1619	-0.1113	-185.53	-0.8991	-145.75	0.1888	0.1298	31.59	0.4231	34.50
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	p-Xylene	1110	ug/mL	0.1400	-0.1400	-0.0962	#DIV/0!	#DIV/0!	#DIV/0!	-0.1400	-0.0962	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	m,p-xylenes	4230	ug/mL	0.5334	-0.4734	-0.3254	-542.36	-1.5019	-349.02	0.1868	0.1284	17.83	0.2064	18.65
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Total Xylenes (m,p, and o)	5990	ug/mL	0.7554	-0.6354	-0.4367	-363.95	-1.2646	-254.16	0.3756	0.2582	22.83	0.2774	24.23
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Total BTEX	8384	ug/mL	1.0573	-0.9373	-0.6442	-536.87	-1.4957	-346.25	0.4654	0.3199	21.01	0.2507	22.18
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	B+T	1224	ug/mL	0.1544										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	E+X	7160	ug/mL	0.9029										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	B/T	0.188349515		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	B/E	0.165811966		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	B/X	0.032387312		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	T/E	0.88034188		0.0001										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	T/X	0.171953255		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	E/X	0.195325543		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	(B+T)/(E+X)	0.170949721		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	1,2,3-Trimethylbenzene	2720	ug/mL	0.3430	-0.3430	-0.2358	#DIV/0!	#DIV/0!	#DIV/0!	0.3308	0.2274	33.75	0.4641	37.13
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	1,2,4-Trimethylbenzene	5590	ug/mL	0.7049	-0.4349	-0.2990	-110.72	-0.6597	-93.41	0.7594	0.5220	35.65	0.5025	39.50
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	1,3,5-Trimethylbenzene	2100	ug/mL	0.2648	-0.2648	-0.1820	#DIV/0!	#DIV/0!	#DIV/0!	0.2435	0.1674	32.93	0.4482	36.12
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Total TMBs	10410	ug/mL	1.3127	-1.0427	-0.7168	-265.47	-1.0871	-196.55	1.3337	0.9168	34.64	0.4819	38.24
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Naphthalene	1280	ug/mL	0.1614	0.9786	0.6727	59.01	1.3437	73.91	0.0933	0.0642	25.19	0.3137	26.93
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	1-MethylNaphthalene	1510	ug/mL	0.1904	1.6496	1.1339	61.62	1.5592	78.97	0.2370	0.1629	38.11	0.5557	42.63
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	2-MethylNaphthalene	2290	ug/mL	0.2888	1.1712	0.8051	55.14	1.1139	67.17	0.0660	0.0454	12.79	0.1415	13.19
NRMRL	JP-8	12/1/95	5/15/97	SJMW1SFP	Total Naphthalenes	5080	ug/mL	0.6406	3.7994	2.6116	58.82	1.3308	73.57	0.3963	0.2724	26.27	0.3310	28.18

Lab	Fuel	Spill	Sample						Smith et al., 1981					Mayfield, 1996				
										Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	LocId	Analyte	Results	Units	Mass Fraction	$C_o - C$	k	%Red./yr	k	%Red./y	$C_o - C$	k	%Red./y	k	%Red./yr
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Density	0.774	g/mL	0.0001										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Benzene	190	ug/mL	0.0245	-0.0245	-0.0169	#DIV/0!	#DIV/0!	#DIV/0!	0.0076	0.0052	16.24	0.1853	16.91
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Toluene	1030	ug/mL	0.1331	-0.1331	-0.0915	#DIV/0!	#DIV/0!	#DIV/0!	0.0753	0.0517	24.83	0.3081	26.52
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Ethylbenzene	1160	ug/mL	0.1499	-0.1499	-0.1030	#DIV/0!	#DIV/0!	#DIV/0!	0.0013	0.0009	0.60	0.0060	0.60
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	m-Xylene	3160	ug/mL	0.4083	-0.3483	-0.2394	-398.99	-1.3181	-273.64	-0.4083	-0.2806	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	o-Xylene	1770	ug/mL	0.2287	-0.1687	-0.1159	-193.25	-0.9197	-150.86	0.1820	0.1251	30.47	0.4025	33.14
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	p-Xylene	1120	ug/mL	0.1447	-0.1447	-0.0995	#DIV/0!	#DIV/0!	#DIV/0!	-0.1447	-0.0995	#DIV/0!	#DIV/0!	#DIV/0!
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	m,p-xylenes	4280	ug/mL	0.5530	-0.4930	-0.3389	-564.77	-1.5266	-360.27	0.1673	0.1150	15.96	0.1817	16.61
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Total Xylenes (m,p, and o)	6050	ug/mL	0.7817	-0.6617	-0.4548	-379.01	-1.2881	-262.59	0.3493	0.2401	21.23	0.2539	22.42
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Total BTEX	8430	ug/mL	1.0891	-0.9691	-0.6662	-555.15	-1.5161	-355.46	0.4335	0.2980	19.57	0.2303	20.57
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	B+T	1220	ug/mL	0.1576										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	E+X	7210	ug/mL	0.9315										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	B/T	0.184466019		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	B/E	0.163793103		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	B/X	0.031404959		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	T/E	0.887931034		0.0001										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	T/X	0.170247934		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	E/X	0.191735537		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	(B+T)/(E+X)	0.169209431		0.0000										
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	1,2,3-Trimethylbenzene	2750	ug/mL	0.3553	-0.3553	-0.2442	#DIV/0!	#DIV/0!	#DIV/0!	0.3185	0.2189	32.49	0.4399	35.59
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	1,2,4-Trimethylbenzene	5650	ug/mL	0.7300	-0.4600	-0.3162	-117.10	-0.6837	-98.11	0.7343	0.5048	34.47	0.4785	38.03
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	1,3,5-Trimethylbenzene	2130	ug/mL	0.2752	-0.2752	-0.1892	#DIV/0!	#DIV/0!	#DIV/0!	0.2331	0.1603	31.53	0.4218	34.41
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Total TMBs	10530	ug/mL	1.3605	-1.0905	-0.7496	-277.62	-1.1116	-203.92	1.2860	0.8839	33.40	0.4574	36.71
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Naphthalene	1290	ug/mL	0.1667	0.9733	0.6691	58.69	1.3217	73.33	0.0881	0.0606	23.77	0.2917	25.30
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	1-MethylNaphthalene	1490	ug/mL	0.1925	1.6475	1.1325	61.55	1.5517	78.81	0.2349	0.1614	37.78	0.5482	42.20
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	2-MethylNaphthalene	2320	ug/mL	0.2997	1.1603	0.7975	54.63	1.0883	66.32	0.0550	0.0378	10.66	0.1158	10.94
NRMRL	JP-8	12/1/95	5/15/97	SJMW2SFP	Total Naphthalenes	5100	ug/mL	0.6589	3.7811	2.5991	58.54	1.3114	73.06	0.3780	0.2598	25.06	0.3117	26.78

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-8 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

Linear (Zero Order) Assumption

linear equation $C = C_o - kt$

summary statistics presented as follows

analyte	
k	C_o
sek	seC_o
r^2	seC
F stat.	df
ss_{regr}	ss_{resid}

k = zero order weathering rate; k = dC/dt or slope
sek = slope standard error value
Co = intercept or initial analyte concentration as calculated by regression analysis
seCo = standard error value for the constant C_o
r^2 = coefficient of determination
seC = standard error value of the estimated concentration C (i.e., a "standard deviation" for the regression line)
F stat. = F statistic or F-observed value
df = degrees of freedom
ss_{regr} = the regression sum of squares
ss_{resid} = the residual sum of squares

Exponential (1st Order) Assumption

exponential equatio $C = C_o e^{-kt}$

summary statistics presented as follows

analyte	
m	C_o
sek	seC_o
r^2	seC
F stat.	df
ss_{regr}	ss_{resid}
	$\ln C_o$

m = coefficient for statistics equation shown; note $m = e^{-kt}$, therefore, ln m = -k
sek = standard error value for the exponential rate constant k
Co = intercept or initial analyte concentration as calculated by regression analysis
seCo = standard error value for the constant C_o; compare to $\ln C_o$
r^2 = coefficient of determination
seC = standard error value of the estimated concentration C (i.e., a "standard deviation" for the regression line)
F stat. = F statistic or F-observed value
df = degrees of freedom
ss_{regr} = the regression sum of squares
ss_{resid} = the residual sum of squares
$\ln C_o$ = natural log of Co for comparing to seCo

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-8 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

SEYMOUR JOHNSON AFB, BLDG 4522

Evergreen Analytical Data

Sample Location	Date	Time (yrs	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	
MW-1S	12/14/95	0.00	0.0321	0.2083	0.1512	1.1310	1.5226	
	5/15/97	1.42	0.0237	0.1341	0.1273	0.7736	1.0587	average of 2 samples
	3/10/98	2.24	0.0061	0.0770	0.1345	0.5501	0.7677	

linear	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	0.0341	0.2105	0.1480	1.1336	1.5261
Predicted C - latest sample date	0.0094	0.0807	0.1290	0.5546	0.7738
linear rate constant (k) (slope)	0.0110	0.0580	0.0085	0.2586	0.3361
average yearly reduction (%)	32.31	27.54	5.74	22.82	22.02

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0110	0.0341	-0.0580	0.2105	-0.0085	0.1480	-0.2586	1.1336	-0.3361	1.5261
0.0040	0.0062	0.0046	0.0070	0.0067	0.0102	0.0055	0.0084	0.0074	0.0113
0.8809	0.0065	0.9939	0.0073	0.6182	0.0107	0.9995	0.0088	0.9995	0.0119
7	1	162	1	2	1	2212	1	2054	1
0.0003	0.0000	0.0086	0.0001	0.0002	0.0001	0.1716	0.0001	0.2898	0.0001

exponential	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	0.0384	0.2180	0.1477	1.1519	1.5485
exponential rate constant (k)	0.6834	0.4297	0.0599	0.3159	0.3004
% reduction/year	49.51	34.93	5.82	27.09	25.95

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.5049	0.0384	0.6507	0.2180	0.9418	0.1477	0.7291	1.1519	0.7405	1.5485
0.3760	0.5754	0.0960	0.1468	0.0491	0.0751	0.0389	0.0595	0.0357	0.0546
0.7676	0.6023	0.9525	0.1537	0.5984	0.0786	0.9851	0.0623	0.9861	0.0571
3	1	20	1	1	1	66	1	71	1
1.1979	0.3627	0.4737	0.0236	0.0092	0.0062	0.2561	0.0039	0.2315	0.0033
	-3.2597		-1.5232		-1.9124		0.1414		0.4373

ANALYSIS OF FREE PRODUCT WEATHERING RATES FOR JP-8 SITES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED

SEYMOUR JOHNSON AFB, BLDG 4522 (continued)
NRMRL Data

Sample Location	Date	Time (yrs	Benzene	Toluene	Ethylbenzene	o-Xylene	m,p-xylenes	Total Xylenes	Total BTEX	
MW-1S	12/14/95	0.00	0.0321	0.2083	0.1512	0.4107	0.7202	1.1310	1.5226	
	7/12/96	0.58	0.0310	0.2057	0.1562	0.2917	0.6575	0.9492	1.3421	
	5/15/97	1.42	0.0245	0.1315	0.1487	0.2253	0.5432	0.7685	1.0732	average of 2 samples
	3/10/98	2.24	0.0058	0.0736	0.0978	0.1271	0.2445	0.3716	0.5488	

linear	Benzene	Toluene	Ethylbenzene	o-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
Co	0.0356	0.2231	0.1629	0.3905	0.7605	1.1510	1.5726
Predicted C - latest sample date	0.0097	0.0787	0.1113	0.1225	0.2972	0.4197	0.6194
linear rate constant (k) (slope)	0.0116	0.0645	0.0231	0.1197	0.2070	0.3267	0.4259
average yearly reduction (%)	32.54	28.91	14.16	30.66	27.22	28.38	27.08

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0116	0.0356	-0.0645	0.2231	-0.0231	0.1629	-0.3267	1.1510	-0.4259	1.5726
0.0032	0.0044	0.0105	0.0143	0.0111	0.0150	0.0406	0.0551	0.0571	0.0775
0.8651	0.0055	0.9493	0.0179	0.6839	0.0188	0.9701	0.0688	0.9653	0.0968
13	2	37	2	4	2	65	2	56	2
0.0004	0.0001	0.0120	0.0006	0.0015	0.0007	0.3067	0.0095	0.5211	0.0187

exponential	Benzene	Toluene	Ethylbenzene	m-Xylene	o-Xylene	p-Xylene	m,p-xylenes	Total Xylenes	Total BTEX
Co	0.0421	0.2379	0.1658	#VALUE!	0.4107	#VALUE!	0.8182	1.2317	1.6719
exponential rate constant (k)	0.7331	0.4827	0.1864	#VALUE!	0.4993	#VALUE!	0.4636	0.4759	0.4416
% reduction/year	51.96	38.29	17.00	#VALUE!	39.31	#VALUE!	37.10	37.87	35.70

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.4804	0.0421	0.6171	0.2379	0.8300	0.1658	0.6213	1.2317	0.6430	1.6719
0.2817	0.3821	0.0956	0.1297	0.0908	0.1231	0.1077	0.1461	0.1017	0.1379
0.7720	0.4776	0.9273	0.1621	0.6783	0.1538	0.9071	0.1826	0.9042	0.1723
7	2	25	2	4	2	20	2	19	2
1.5441	0.4561	0.6695	0.0525	0.0998	0.0473	0.6509	0.0667	0.5604	0.0594
	-3.1674		-1.4359		-1.7967		0.2084		0.5140

									Ghassemi *et al.*, 1984					Mid-Range (Potter, 1988), AD Little, Inc. (1987), & Sigsby *et al.* (1987)				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Benzene	14000000	ug/L	1.9391	-0.4391	-0.0621	-4.14	-0.0363	-3.70	0.7928	0.1122	4.11	0.0485	4.74
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Toluene	52000000	ug/L	7.2022	-1.3022	-0.1843	-3.12	-0.0282	-2.86	5.3097	0.7515	6.01	0.0782	7.52
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Ethylbenzene	12000000	ug/L	1.6620	-0.3620	-0.0512	-3.94	-0.0348	-3.54	0.0187	0.0027	0.16	0.0016	0.16
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Total Xylenes (m,p, and o)	57000000	ug/L	7.8947	-1.9947	-0.2823	-4.78	-0.0412	-4.21	-0.3480	-0.0492	-0.65	-0.0064	-0.64
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Total BTEX	135000000	ug/L	18.6981	-4.0981	-0.5800	-3.97	-0.0350	-3.56	5.7733	0.8171	3.34	0.0381	3.74
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B+T	66000000	ug/L	9.1413										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	E+X	69000000	ug/L	9.5568										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B/T	0.26923077		0.0000										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B/E	1.16666667		0.0000										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B/X	0.24561404		0.0000										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	T/E	4.33333333		0.0000										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	T/X	0.9122807		0.0000										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	E/X	0.21052632		0.0000										
EAL	Gasoline	6/1/90	6/23/97	MW-349-6FP	(B+T)/(E+X)	0.95652174		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Density	0.722	g/mL	0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Benzene	9450	ug/mL	1.3089	0.1911	0.0271	1.80	0.0193	1.91	1.4230	0.2014	7.37	0.1041	9.89
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Toluene	40600	ug/mL	5.6233	0.2767	0.0392	0.66	0.0068	0.68	6.8887	0.9749	7.79	0.1132	10.70
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Ethylbenzene	13300	ug/mL	1.8421	-0.5421	-0.0767	-5.90	-0.0493	-5.06	-0.1613	-0.0228	-1.36	-0.0130	-1.31
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	m-Xylene	23500	ug/mL	3.2548										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	o-Xylene	11000	ug/mL	1.5235										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	p-Xylene	9210	ug/mL	1.2756										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	m,p-xylenes	32710	ug/mL	4.5305										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Total Xylenes (m,p, and o)	43710	ug/mL	6.0540	-0.1540	-0.0218	-0.37	-0.0036	-0.37	1.4928	0.2113	2.80	0.0312	3.07
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Total BTEX	107060	ug/mL	14.8283	-0.2283	-0.0323	-0.22	-0.0022	-0.22	9.6431	1.3648	5.58	0.0709	6.84
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B+T	50050	ug/mL	6.9321										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	E+X	57010	ug/mL	7.8961										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B/T	0.23275862		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B/E	0.71052632		0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	B/X	0.21619767		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	T/E	3.05263158		0.0004										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	T/X	0.92884923		0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	E/X	0.3042782		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	(B+T)/(E+X)	0.87791616		0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	1,2,3-Trimethylbenzene	3870	ug/mL	0.5360										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	1,2,4-Trimethylbenzene	15700	ug/mL	2.1745										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	1,3,5-Trimethylbenzene	4560	ug/mL	0.6316										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Total TMBs	24130	ug/mL	3.3421										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Naphthalene	2080	ug/mL	0.2881										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	1-MethylNaphthalene	900	ug/mL	0.1247										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	2-MethylNaphthalene	1860	ug/mL	0.2576										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-6FP	Total Naphthalenes	4840	ug/mL	0.6704										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Density	0.744	g/mL	0.0001										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Benzene	2600	ug/mL	0.3495	1.1505	0.1368	9.12	0.1732	15.90	2.3824	0.2833	10.37	0.2445	21.69
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Toluene	25640	ug/mL	3.4462	2.4538	0.2917	4.94	0.0639	6.19	9.0657	1.0778	8.61	0.1533	14.21
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Ethylbenzene	10120	ug/mL	1.3602	-0.0602	-0.0072	-0.55	-0.0054	-0.54	0.3206	0.0381	2.27	0.0252	2.48
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	m-Xylene	23720	ug/mL	3.1882										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	o-Xylene	11840	ug/mL	1.5914										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	p-Xylene	9520	ug/mL	1.2796										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	m,p-xylenes	33240	ug/mL	4.4677										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Total Xylenes (m,p, and o)	45080	ug/mL	6.0591	-0.1591	-0.0189	-0.32	-0.0032	-0.32	1.4876	0.1769	2.34	0.0261	2.58
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Total BTEX	83440	ug/mL	11.2151	3.3849	0.4024	2.76	0.0314	3.09	13.2563	1.5761	6.44	0.0928	8.86
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	B+T	28240	ug/mL											
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	E+X	55200	ug/mL											
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	B/T	0.10140406												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	B/E	0.256917												

															Mid-Range (Potter, 1988),			
									Ghasseml *et al.*, 1984					AD Little, Inc. (1987), & Sigsby *et al.* (1987)				
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential	
Code	Type	Date	Date	Locld	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	B/X	0.05767524												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	T/E	2.53359684												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	T/X	0.56876664												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	E/X	0.2244898												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	(B+T)/(E+X)	0.5115942												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	1,2,3-Trimethylbenzene	3880	ug/mL	0.5215										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	1,2,4-Trimethylbenzene	15640	ug/mL	2.1022										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	1,3,5-Trimethylbenzene	5560	ug/mL	0.7473										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Total TMBs	25080	ug/mL	3.3710										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Naphthalene	1920	ug/mL	0.2581										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	1-MethylNaphthalene	880	ug/mL	0.1183										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	2-MethylNaphthalene	1960	ug/mL	0.2634										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-6	Total Naphthalenes	4760	ug/mL	0.6398										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Density	0.738	g/mL	0.0001										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Benzene	8280	ug/mL	1.1220	0.3780	0.0848	5.65	0.0651	6.30	1.6099	0.3609	13.21	0.1995	18.09
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Toluene	41100	ug/mL	5.5691	0.3309	0.0742	1.26	0.0129	1.29	6.9428	1.5566	12.44	0.1815	16.60
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Ethylbenzene	10300	ug/mL	1.3957	-0.0957	-0.0214	-1.65	-0.0159	-1.60	0.2851	0.0639	3.80	0.0417	4.08
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	m-Xylene	21700	ug/mL	2.9404										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	o-Xylene	11400	ug/mL	1.5447										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	p-Xylene	8980	ug/mL	1.2168										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	m,p-xylenes	30680	ug/mL	4.1572										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Total Xylenes (m,p, and o)	42080	ug/mL	5.7019	0.1981	0.0444	0.75	0.0077	0.76	1.8449	0.4136	5.48	0.0628	6.09
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Total BTEX	101760	ug/mL	13.7886	0.8114	0.1819	1.25	0.0128	1.27	10.6828	2.3951	9.79	0.1286	12.07
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	B+T	49380	ug/mL	6.6911										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	E+X	52380	ug/mL	7.0976										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	B/T	0.20145985		0.0000										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	B/E	0.8038835		0.0001										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	B/X	0.19676806		0.0000										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	T/E	3.99029126		0.0005										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	T/X	0.97671103		0.0001										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	E/X	0.24477186		0.0000										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	(B+T)/(E+X)	0.94272623		0.0001										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Naphthalene	1850	ug/mL	0.2507										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	1-MethylNaphthalene	894	ug/mL	0.1211										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	2-MethylNaphthalene	1600	ug/mL	0.2168										
NRMRL	Gasoline	6/1/90	11/15/94	MW349-1	Total Naphthalenes	4344	ug/mL	0.5886										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	Density	0.724	g/mL	0.0001										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	Benzene	8420	ug/mL	1.1630	0.3370	0.0555	3.70	0.0419	4.10	1.5689	0.2583	9.45	0.1406	13.12
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	Toluene	36400	ug/mL	5.0276	0.8724	0.1436	2.43	0.0263	2.60	7.4843	1.2322	9.85	0.1501	13.94
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	Ethylbenzene	11400	ug/mL	1.5746	-0.2746	-0.0452	-3.48	-0.0315	-3.21	0.1062	0.0175	1.04	0.0107	1.07
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	m-Xylene	17700	ug/mL	2.4448										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	o-Xylene	10700	ug/mL	1.4779										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	p-Xylene	9360	ug/mL	1.2928										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	m,p-xylenes	27060	ug/mL	3.7376										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	Total Xylenes (m,p, and o)	37760	ug/mL	5.2155	0.6845	0.1127	1.91	0.0203	2.01	2.3313	0.3838	5.09	0.0608	5.90
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	Total BTEX	93980	ug/mL	12.9807	1.6193	0.2666	1.83	0.0194	1.92	11.4907	1.8918	7.73	0.1044	9.91
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	B+T	44820	ug/mL	6.1906										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	E+X	49160	ug/mL	6.7901										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	B/T	0.23131868		0.0000										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	B/E	0.73859649		0.0001										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	B/X	0.22298729		0.0000										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	T/E	3.19298246		0.0004										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	T/X	0.96398305		0.0001										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	E/X	0.30190678		0.0000										
NRMRL	Gasoline	6/1/90	6/26/96	MW349-1	(B+T)/(E+X)	0.91171684		0.0001										

									Ghassemi *et al.*, 1984					Mid-Range (Potter, 1988), AD Little, Inc. (1987), & Sigsby *et al.* (1987)				
										Linear		Exponential			Linear		Exponential	
Lab Code	Fuel Type	Spill Date	Sample Date	LocId	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Density	0.72	g/mL	0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Benzene	8310	ug/mL	1.1542	0.3458	0.0489	3.26	0.0371	3.64	1.5777	0.2233	8.17	0.1219	11.48
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Toluene	40000	ug/mL	5.5556	0.3444	0.0487	0.83	0.0085	0.85	6.9564	0.9845	7.87	0.1149	10.85
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Ethylbenzene	11100	ug/mL	1.5417	-0.2417	-0.0342	-2.63	-0.0241	-2.44	0.1391	0.0197	1.17	0.0122	1.22
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	m-Xylene	23300	ug/mL	3.2361										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	o-Xylene	10600	ug/mL	1.4722										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	p-Xylene	9040	ug/mL	1.2556										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Total Xylenes (m,p, and o)	42940	ug/mL	5.9639	-0.0639	-0.0090	-0.15	-0.0015	-0.15	1.5829	0.2240	2.97	0.0333	3.28
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Total BTEX	102350	ug/mL	14.2153	0.3847	0.0544	0.37	0.0038	0.38	10.2561	1.4515	5.93	0.0769	7.40
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	B+T	48310	ug/mL	6.7097										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	E+X	54040	ug/mL	7.5056										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	B/T	0.20775		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	B/E	0.74864865		0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	B/X	0.19352585		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	T/E	3.6036036		0.0005										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	T/X	0.93153237		0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	E/X	0.25850023		0.0000										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	(B+T)/(E+X)	0.89396743		0.0001										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	1,2,3-Trimethylbenzene	3450	ug/mL	0.4792										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	1,2,4-Trimethylbenzene	14800	ug/mL	2.0556										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	1,3,5-Trimethylbenzene	4340	ug/mL	0.6028										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	Naphthalene	2170	ug/mL	0.3014										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	1-MethylNaphthalene	1100	ug/mL	0.1528										
NRMRL	Gasoline	6/1/90	6/23/97	MW-349-1FP	2-MethylNaphthalene	2280	ug/mL	0.3167										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Density	0.728	g/mL	0.0001										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Benzene	7400	ug/mL	1.0165	0.4835	0.0575	3.83	0.0463	4.52	1.7154	0.2039	7.47	0.1175	11.09
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Toluene	35000	ug/mL	4.8077	1.0923	0.1299	2.20	0.0243	2.40	7.7043	0.9160	7.32	0.1137	10.75
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Ethylbenzene	11840	ug/mL	1.6264	-0.3264	-0.0388	-2.98	-0.0266	-2.70	0.0544	0.0065	0.38	0.0039	0.39
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	m-Xylene	23360	ug/mL	3.2088										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	o-Xylene	11720	ug/mL	1.6099										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	p-Xylene	9360	ug/mL	1.2857										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	m,p-xylenes	32720	ug/mL	4.4945										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Total Xylenes (m,p, and o)	44440	ug/mL	6.1044	-0.2044	-0.0243	-0.41	-0.0040	-0.41	1.4424	0.1715	2.27	0.0252	2.49
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Total BTEX	98680	ug/mL	13.5549	1.0451	0.1242	0.85	0.0088	0.88	10.9164	1.2979	5.30	0.0702	6.78
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	B+T	42400	ug/mL											
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	E+X	56280	ug/mL											
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	B/T	0.21142857												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	B/E	0.625												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	B/X	0.16651665												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	T/E	2.95608108												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	T/X	0.78757876												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	E/X	0.26642664												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	(B+T)/(E+X)	0.75337598												
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	1,2,3-Trimethylbenzene	3120	ug/mL	0.4286										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	1,2,4-Trimethylbenzene	12560	ug/mL	1.7253										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	1,3,5-Trimethylbenzene	4600	ug/mL	0.6319										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Total TMBs	20280	ug/mL	2.7857										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Naphthalene	2000	ug/mL	0.2747										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	1-MethylNaphthalene	920	ug/mL	0.1264										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	2-MethylNaphthalene	2040	ug/mL	0.2802										
NRMRL	Gasoline	6/1/90	10/27/98	MW349-1	Total Naphthalenes	4960	ug/mL	0.6813										

															Mid-Range (Potter, 1988),				
									Ghassemi *et al.*, 1984					AD Little, Inc. (1987), & Sigsby *et al.* (1987)					
Lab	Fuel	Spill	Sample							Linear		Exponential			Linear		Exponential		
Code	Type	Date	Date	Locid	Analyte	Results	Units	Mass Fraction	C_o - C	k	%Red./yr	k	%Red./yr	C_o - C	k	%Red./yr	k	%Red./yr	
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Density	0.737	g/mL	0.0001											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Benzene	5620	ug/mL	0.7626	0.7374	0.1653	11.02	0.1517	14.07	1.9693	0.4415	16.16	0.2861	24.88	
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Toluene	28600	ug/mL	3.8806	2.0194	0.4528	7.67	0.0939	8.97	8.6314	1.9352	15.47	0.2625	23.09	
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Ethylbenzene	9260	ug/mL	1.2564	0.0436	0.0098	0.75	0.0076	0.76	0.4243	0.0951	5.66	0.0652	6.32	
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	m-Xylene	21400	ug/mL	2.9037											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	o-Xylene	11600	ug/mL	1.5739											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	p-Xylene	8920	ug/mL	1.2103											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	m,p-xylenes	30320	ug/mL	4.1140											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Total Xylenes (m,p, and o)	41920	ug/mL	5.6879	0.2121	0.0475	0.81	0.0082	0.82	1.8589	0.4168	5.52	0.0634	6.14	
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Total BTEX	85400	ug/mL	11.5875	3.0125	0.6754	4.63	0.0518	5.05	12.8839	2.8886	11.80	0.1676	15.43	
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	B+T	34220	ug/mL	4.6431											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	E+X	51180	ug/mL	6.9444											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	B/T	0.1965035		0.0000											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	B/E	0.60691145		0.0001											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	B/X	0.13406489		0.0000											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	T/E	3.08855292		0.0004											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	T/X	0.68225191		0.0001											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	E/X	0.22089695		0.0000											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	(B+T)/(E+X)	0.66862055		0.0001											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Naphthalene	2170	ug/mL	0.2944											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	1-MethylNaphthalene	749	ug/mL	0.1016											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	2-MethylNaphthalene	1420	ug/mL	0.1927											
NRMRL	Gasoline	6/1/90	11/15/94	MW349-7	Total Naphthalenes	4339	ug/mL	0.5887											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	Density	0.742	g/mL	0.0001											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	Benzene	955	ug/mL	0.1287	1.3713	0.2258	15.05	0.4043	33.26	2.6032	0.4286	15.69	0.5030	39.53	
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	Toluene	12300	ug/mL	1.6577	4.2423	0.6984	11.84	0.2090	18.86	10.8543	1.7870	14.28	0.3328	28.31	
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	Ethylbenzene	10100	ug/mL	1.3612	-0.0612	-0.0101	-0.77	-0.0076	-0.76	0.3196	0.0526	3.13	0.0347	3.41	
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	m-Xylene	15400	ug/mL	2.0755											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	o-Xylene	9150	ug/mL	1.2332											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	p-Xylene	8030	ug/mL	1.0822											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	m,p-xylenes	23430	ug/mL	3.1577											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	Total Xylenes (m,p, and o)	32580	ug/mL	4.3908	1.5092	0.2485	4.21	0.0486	4.75	3.1559	0.5196	6.88	0.0892	8.53	
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	Total BTEX	55935	ug/mL	7.5384	7.0616	1.1626	7.96	0.1088	10.31	16.9330	2.7878	11.39	0.1939	17.62	
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	B+T	13255	ug/mL	1.7864											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	E+X	42680	ug/mL	5.7520											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	B/T	0.07764228		0.0000											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	B/E	0.09455446		0.0000											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	B/X	0.02931246		0.0000											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	T/E	1.21782178		0.0002											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	T/X	0.37753223		0.0001											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	E/X	0.31000614		0.0000											
NRMRL	Gasoline	6/1/90	6/26/96	MW349-8	(B+T)/(E+X)	0.31056701		0.0000											

ANALYSIS OF GASOLINE FREE PRODUCT WEATHERING RATES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED, MW349-1
TANK 349, OFFUTT AFB (NRMRL DATA ONLY)

Linear (Zero Order) Assumption

linear equation $C = C_o - kt$

summary statistics presented as follows

analyte	
k	C_o
sek	seC_o
r^2	seC
F stat.	df
ss_{regr}	ss_{resid}

k = zero order weathering rate; k = dC/dt or slope
sek = slope standard error value
Co = intercept or initial analyte concentration as calculated by regression analysis
seCo = standard error value for the constant C_o
r^2 = coefficient of determination
seC = standard error value of the estimated concentration C (i.e., a "standard deviation" for the regression line)
F stat. = F statistic or F-observed value
df = degrees of freedom
ss_{regr} = the regression sum of squares
ss_{resid} = the residual sum of squares

Exponential (1st Order) Assumption

exponential equation $C = C_o e^{-kt}$

summary statistics presented as follows

analyte	
m	C_o
sek	seC_o
r^2	seC
F stat.	df
ss_{regr}	ss_{resid}
	$\ln C_o$

m = coefficient for statistics equation shown; note $m = e^{-kt}$, therefore, ln m = -k
sek = standard error value for the exponential rate constant k
Co = intercept or initial analyte concentration as calculated by regression analysis
seCo = standard error value for the constant C_o; compare to $\ln C_o$
r^2 = coefficient of determination
seC = standard error value of the estimated concentration C (i.e., a "standard deviation" for the regression line)
F stat. = F statistic or F-observed value
df = degrees of freedom
ss_{regr} = the regression sum of squares
ss_{resid} = the residual sum of squares
$\ln C_o$ = natural log of Co for comparing to seCo

ANALYSIS OF GASOLINE FREE PRODUCT WEATHERING RATES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED, MW349-1
TANK 349, OFFUTT AFB (NRMRL DATA ONLY)

Sample			**Ghassemi et al., 1984**					
Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	
MW-349-1	6/1/90	0.00	1.50	5.90	1.30	5.90	14.60	initial concentrations from Ghassemi *et al.*, 1984
	11/15/94	4.46	1.12	5.57	1.40	5.70	13.79	
	6/26/96	6.07	1.16	5.03	1.57	5.22	12.98	
	6/23/97	7.07	1.15	5.56	1.54	5.96	14.22	
	10/27/98	8.41	1.02	4.81	1.63	6.10	13.55	

linear					
Co	1.4638	5.9475	1.2820	5.7370	14.4303
Predicted C - latest sample date	1.0229	5.0170	1.6145	5.8019	13.4563
linear rate constant (k) (slope)	0.0524	0.1106	-0.0395	-0.0077	0.1158
average yearly reduction (%)	3.58	1.86	-3.08	-0.13	0.80

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0524	1.4638	-0.1106	5.9475	0.0395	1.2820	0.0077	5.7370	-0.1158	14.4303
0.0116	0.0691	0.0464	0.2767	0.0077	0.0460	0.0613	0.3654	0.0878	0.5232
0.8718	0.0753	0.6541	0.3015	0.8974	0.0501	0.0052	0.3982	0.3669	0.5701
20	3	6	3	26	3	0	3	2	3
0.1158	0.0170	0.5157	0.2727	0.0659	0.0075	0.0025	0.4757	0.5651	0.9750

exponential	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	1.4644	5.9613	1.2862	5.7351	14.4234
exponential rate constant (k)	0.0414	0.0205	-0.0273	-0.0011	0.0083
% reduction/year	4.05	2.03	-2.77	-0.11	0.82

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.9595	1.4644	0.9797	5.9613	1.0277	1.2862	1.0011	5.7351	0.9918	14.4234
0.0093	0.0554	0.0089	0.0533	0.0050	0.0300	0.0109	0.0650	0.0064	0.0384
0.8682	0.0604	0.6378	0.0580	0.9072	0.0327	0.0035	0.0709	0.3544	0.0418
20	3	5	3	29	3	0	3	2	3
0.0721	0.0109	0.0178	0.0101	0.0314	0.0032	0.0001	0.0151	0.0029	0.0052
	0.3815		1.7853		0.2517		1.7466		2.6689

ANALYSIS OF GASOLINE FREE PRODUCT WEATHERING RATES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED, MW349-1
TANK 349, OFFUTT AFB (NRMRL DATA ONLY)

Sample Location	Date	Time (yrs)	Mid-range Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX	
MW-349-1	6/1/90	0.00	2.73	12.51	1.68	7.55	24.47	mid-range initial concentrations as presented by Potter (1988), AD Little (1987), and
	11/15/94	4.46	1.12	5.57	1.40	5.70	13.79	Sigsby et al., (1987)
	6/26/96	6.07	1.16	5.03	1.57	5.22	12.98	
	6/23/97	7.07	1.15	5.56	1.54	5.96	14.22	
	10/27/98	8.41	1.02	4.81	1.63	6.10	13.55	

linear	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	2.5013	11.5159	1.6027	7.1239	22.7438
Predicted C - latest sample date	0.7813	3.7204	1.5398	5.4789	11.5205
linear rate constant (k) (slope)	0.2045	0.9268	0.0075	0.1956	1.3344
average yearly reduction (%)	8.18	8.05	0.47	2.75	5.87

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.2045	2.5013	-0.9268	11.5159	-0.0075	1.6027	-0.1956	7.1239	-1.3344	22.7438
0.0523	0.3115	0.2275	1.3554	0.0187	0.1113	0.1067	0.6359	0.3948	2.3519
0.8360	0.3394	0.8469	1.4770	0.0506	0.1213	0.5281	0.6930	0.7920	2.5628
15	3	17	3	0	3	3	3	11	3
1.7622	0.3456	36.2004	6.5446	0.0024	0.0441	1.6118	1.4406	75.0347	19.7041

exponential	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	2.4263	11.2277	1.5969	7.0563	22.2830
exponential rate constant (k)	0.1154	0.1133	0.0044	0.0293	0.0720
% reduction/year	10.90	10.72	0.44	2.88	6.95

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.8910	2.4263	0.8928	11.2277	0.9956	1.5969	0.9712	7.0563	0.9305	22.2830
0.0276	0.1646	0.0257	0.1533	0.0123	0.0732	0.0175	0.1041	0.0218	0.1297
0.8533	0.1793	0.8660	0.1671	0.0410	0.0798	0.4834	0.1134	0.7849	0.1413
17	3	19	3	0	3	3	3	11	3
0.5610	0.0965	0.5413	0.0837	0.0008	0.0191	0.0361	0.0386	0.2186	0.0599
	0.8864		2.4184		0.4681		1.9539		3.1038

ANALYSIS OF GASOLINE FREE PRODUCT WEATHERING RATES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED, MW349-1
TANK 349, OFFUTT AFB (NRMRL DATA ONLY)

Sample			Measured Data Only				
Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
MW-349-1	11/15/94	0.00	1.12	5.57	1.40	5.70	13.79
	6/26/96	1.61	1.16	5.03	1.57	5.22	12.98
	6/23/97	2.61	1.15	5.56	1.54	5.96	14.22
	10/27/98	3.95	1.02	4.81	1.63	6.10	13.55

linear	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	1.1632	5.5418	1.4251	5.4702	13.6003
Predicted C - latest sample date	1.0678	4.9580	1.6369	6.0044	13.6672
linear rate constant (k) (slope)	0.0241	0.1478	-0.0536	-0.1352	-0.0169
average yearly reduction (%)	2.08	2.67	-3.76	-2.47	-0.12

linear
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
-0.0241	1.1632	-0.1478	5.5418	0.0536	1.4251	0.1352	5.4702	0.0169	13.6003
0.0229	0.0573	0.1247	0.3116	0.0181	0.0454	0.1360	0.3399	0.2183	0.5458
0.3567	0.0661	0.4126	0.3594	0.8135	0.0523	0.3309	0.3920	0.0030	0.6295
1	2	1	2	9	2	1	2	0	2
0.0048	0.0087	0.1815	0.2584	0.0239	0.0055	0.1520	0.3073	0.0024	0.7925

exponential	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	1.1649	5.5444	1.4246	5.4696	13.5927
exponential rate constant (k)	0.0226	0.0286	-0.0356	-0.0233	-0.0013
% reduction/year	2.23	2.82	-3.63	-2.36	-0.13

exponential
summary stats

Benzene		Toluene		Ethylbenzene		Total Xylenes		Total BTEX	
0.9777	1.1649	0.9718	5.5444	1.0363	1.4246	1.0236	5.4696	1.0013	13.5927
0.0209	0.0524	0.0238	0.0595	0.0123	0.0306	0.0245	0.0612	0.0161	0.0402
0.3678	0.0604	0.4197	0.0686	0.8087	0.0353	0.3117	0.0706	0.0030	0.0464
1	2	1	2	8	2	1	2	0	2
0.0042	0.0073	0.0068	0.0094	0.0106	0.0025	0.0045	0.0100	0.0000	0.0043
	0.1526		1.7128		0.3539		1.6992		2.6095

ANALYSIS OF GASOLINE FREE PRODUCT WEATHERING RATES WHERE 2 OR MORE SAMPLING EVENTS HAVE BEEN PERFORMED, MW349-1
TANK 349, OFFUTT AFB (NRMRL DATA ONLY)

Sample			**1997 and 1998 Data Only**				
Location	Date	Time (yrs)	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
MW-349-1	6/23/97	0.00	1.15	5.56	1.54	5.96	14.22
	10/27/98	1.35	1.02	4.81	1.63	6.10	13.55
linear							
Co			1.1542	5.5556	1.5417	5.9639	14.2153
Predicted C - latest sample date			1.0165	4.8077	1.6264	6.1044	13.5549
linear rate constant (k) (slope)			0.1024	0.5559	-0.0630	-0.1045	0.4909
average yearly reduction (%)			8.87	10.01	-4.08	-1.75	3.45

exponential	Benzene	Toluene	Ethylbenzene	Total Xylenes	Total BTEX
Co	1.1542	5.5556	1.5417	5.9639	14.2153
exponential rate constant (k)	0.0944	0.1075	-0.0398	-0.0173	0.0354
% reduction/year	9.01	10.19	-4.06	-1.75	3.47

APPENDIX C-2

K_{fw} CALCULATIONS

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocid	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
3	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Benzene	280	50000	ug/L	14000000	ug/L
	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	10/27/98	OFMW349-6	Benzene	340.909091	8800	ug/L	3000000	ug/L
							Analyte avg kfw	310.454545				
3	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Toluene	787.878788	66000	ug/L	52000000	ug/L
	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	10/27/98	OFMW349-6	Toluene	1500	20000	ug/L	30000000	ug/L
							Analyte avg kfw	1143.93939				
3	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Ethylbenzene	1200	10000	ug/L	12000000	ug/L
	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	10/27/98	OFMW349-6	Ethylbenzene	6666.66667	1800	ug/L	12000000	ug/L
							Analyte avg kfw	3933.33333				
3	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Total Xylenes (m,p, and o)	1266.66667	45000	ug/L	57000000	ug/L
	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	10/27/98	OFMW349-6	o-Xylene	4857.14286	3500	ug/L	17000000	ug/L
	EAL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	10/27/98	OFMW349-6	m,p-Xylene	6727.27273	5500	ug/L	37000000	ug/L
2	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Benzene	216.666667	6000	ug/L	1300000	ug/L
1	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Benzene	265	10000	ug/L	2650000	ug/L
							Analyte avg kfw	240.833333				
2	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Toluene	789.473684	3800	ug/L	3000000	ug/L
1	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Toluene	945.634267	6070	ug/L	5740000	ug/L
							Analyte avg kfw	867.553976				
2	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Ethylbenzene	3414.63415	410	ug/L	1400000	ug/L
1	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Ethylbenzene	4059.63303	436	ug/L	1770000	ug/L
							Analyte avg kfw	3737.13359				
2	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	o-Xylene	2583.33333	1200	ug/L	3100000	ug/L
1	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	o-Xylene	2837.39837	1230	ug/L	3490000	ug/L
							Analyte avg kfw	2710.36585				
2	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	m,p-Xylene	3105.26316	1900	ug/L	5900000	ug/L
1	EAL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	m,p-Xylene	3435.77982	2180	ug/L	7490000	ug/L
							Analyte avg kfw	3270.52149				
				06/01/94	03/11/98	SH98-1610-2	Total Xylenes (m,p, and o)	2903.22581	3100	ug/L	9000000	ug/L
				06/01/94	03/06/97	SHMW1610-2	Total Xylenes (m,p, and o)	3219.94135	3410	ug/L	10980000	ug/L
							Analyte avg kfw	3061.58358				
1	EAL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW8I	Benzene	202.884615	1040	ug/L	211000	ug/L
1	EAL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW8I	Toluene	1508	5	ug/L	7540	ug/L
1	EAL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW8I	Ethylbenzene	3553.39806	515	ug/L	1830000	ug/L
1	EAL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW8I	o-Xylene	13909.0909	11	ug/L	153000	ug/L
1	EAL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW8I	m,p-Xylene	3568.96552	1740	ug/L	6210000	ug/L
				01/01/81	03/04/97	MBMW8I	Total Xylenes (m,p, and o)	3633.92347	1751	ug/L	6363000	ug/L
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/17/97	CH-EW6	Benzene	10.8695652	2.3	ug/L	25	ug/L
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Benzene	5	5	ug/L	25	ug/L
							Analyte avg kfw	7.93478261				
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/17/97	CH-EW6	Toluene	1350	1	ug/L	1350	ug/L
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Toluene	1020	200	ug/L	204000	ug/L
							Analyte avg kfw	1185				
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/17/97	CH-EW6	Ethylbenzene	4805.26316	19	ug/L	91300	ug/L

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocId	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Ethylbenzene	3692.30769	260	ug/L	960000	ug/L
							Analyte avg kfw	4248.78543				
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/17/97	CH-EW6	Total Xylenes (m,p, and o)	24705.8824	85	ug/L	2100000	ug/L
3	EAL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Total Xylenes (m,p, and o)	3600	1500	ug/L	5400000	ug/L
							Analyte avg kfw	14152.9412				
1	EAL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Benzene	384.615385	5200	ug/L	2000000	ug/L
1	EAL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Toluene	40000	25	ug/L	1000000	ug/L
1	EAL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Ethylbenzene	5500	1000	ug/L	5500000	ug/L
1	EAL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	o-Xylene	4300	1000	ug/L	4300000	ug/L
1	EAL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	m,p-Xylene	4782.6087	4600	ug/L	22000000	ug/L
				10/01/73	08/27/97	EAKMW316-FP	Total Xylenes (m,p, and o)	4696.42857	5600	ug/L	26300000	ug/L
1	EAL	Facility 293, Cecil Field NAS, FL	JP-5	06/01/81	05/20/97	CEF-293-9FP	Benzene	252.688172	93	ug/L	23500	ug/L
1	EAL	Facility 293, Cecil Field NAS, FL	JP-5	06/01/81	05/20/97	CEF-293-9FP	Toluene	1469.87952	83	ug/L	122000	ug/L
1	EAL	Facility 293, Cecil Field NAS, FL	JP-5	06/01/81	05/20/97	CEF-293-9FP	Ethylbenzene	5818.18182	550	ug/L	3200000	ug/L
1	EAL	Facility 293, Cecil Field NAS, FL	JP-5	06/01/81	05/20/97	CEF-293-9FP	Total Xylenes (m,p, and o)	6636.36364	1100	ug/L	7300000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Benzene	557.5	4	ug/L	2230	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Toluene	1250	16	ug/L	20000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Ethylbenzene	4571.42857	35	ug/L	160000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	o-Xylene	2538.46154	130	ug/L	330000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	m,p-Xylene	4857.14286	140	ug/L	680000	ug/L
				06/01/90	08/12/97	BFT-401-3	Total Xylenes (m,p, and o)	3740.74074	270	ug/L	1010000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	05/19/97	Fresh JP-5	Benzene	454.545455	3.3	ug/L	1500	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	05/19/97	Fresh JP-5	Toluene	1500	24	ug/L	36000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	05/19/97	Fresh JP-5	Ethylbenzene	4567.90123	81	ug/L	370000	ug/L
1	EAL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	05/19/97	Fresh JP-5	Total Xylenes (m,p, and o)	4814.81481	540	ug/L	2600000	ug/L
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Benzene	208.333333	720	ug/L	150000	ug/L
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW2SFP	Benzene	271.604938	810	ug/L	220000	ug/L
							Analyte avg kfw	239.969136				
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Toluene	1010.10101	990	ug/L	1000000	ug/L
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW2SFP	Toluene	1000	1100	ug/L	1100000	ug/L
							Analyte avg kfw	1005.05051				
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Ethylbenzene	2724.13793	290	ug/L	790000	ug/L
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW2SFP	Ethylbenzene	3529.41176	340	ug/L	1200000	ug/L
							Analyte avg kfw	3126.77485				
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Total Xylenes (m,p, and o)	2888.88889	1800	ug/L	5200000	ug/L
3	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW2SFP	Total Xylenes (m,p, and o)	3285.71429	2100	ug/L	6900000	ug/L
							Analyte avg kfw	3087.30159				
4	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MW1S	Benzene	277.777778	180	ug/L	50000	ug/L
4	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MW1S	Toluene	797.468354	790	ug/L	630000	ug/L
4	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MW1S	Ethylbenzene	3548.3871	310	ug/L	1100000	ug/L

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocId	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
4	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MW1S	m,p-Xylene	3827.16049	810	ug/L	3100000	ug/L
4	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MW1S	o-Xylene	2745.09804	510	ug/L	1400000	ug/L
4	EAL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MW1S	Total Xylenes (m,p, and o)	3409.09091	1320	ug/L	4500000	ug/L

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocId	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	Benzene	237.428571	35000	ug/L	8310	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Benzene	245.837669	38440	ug/L	9450	ug/mL
1	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	11/15/94	MW349-1	Benzene	243.529412	34000	ug/L	8280	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-1	Benzene	263.125	32000	ug/L	8420	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-8	Benzene	99.8953975	9560	ug/L	955	ug/mL
							Analyte Kfw avg	217.96321				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	Toluene	943.396226	42400	ug/L	40000	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Toluene	925.672595	43860	ug/L	40600	ug/mL
1	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	11/15/94	MW349-1	Toluene	1151.2605	35700	ug/L	41100	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-1	Toluene	916.876574	39700	ug/L	36400	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-8	Toluene	512.5	24000	ug/L	12300	ug/mL
							Analyte Kfw avg	889.94118				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	Ethylbenzene	2439.56044	4550	ug/L	11100	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Ethylbenzene	3333.33333	3990	ug/L	13300	ug/mL
1	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	11/15/94	MW349-1	Ethylbenzene	2877.09497	3580	ug/L	10300	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-1	Ethylbenzene	2714.28571	4200	ug/L	11400	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-8	Ethylbenzene	2544.0806	3970	ug/L	10100	ug/mL
							Analyte Kfw avg	2781.67101				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	o-Xylene	1859.64912	5700	ug/L	10600	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	o-Xylene	2365.5914	4650	ug/L	11000	ug/mL
1	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	11/15/94	MW349-1	o-Xylene	2456.89655	4640	ug/L	11400	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-1	o-Xylene	2383.0735	4490	ug/L	10700	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-8	o-Xylene	2188.99522	4180	ug/L	9150	ug/mL
							Analyte Kfw avg	2250.84116				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	m-Xylene	2817.41233	8270	ug/L	23300	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	m-Xylene	3466.0767	6780	ug/L	23500	ug/mL
1	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	11/15/94	MW349-1	m-Xylene	3167.88321	6850	ug/L	21700	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-1	m-Xylene	2572.67442	6880	ug/L	17700	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-8	m-Xylene	2475.88424	6220	ug/L	15400	ug/mL
							Analyte Kfw avg	2899.98618				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	p-Xylene	2560.90652	3530	ug/L	9040	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	p-Xylene	3209.05923	2870	ug/L	9210	ug/mL
1	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	11/15/94	MW349-1	p-Xylene	3218.63799	2790	ug/L	8980	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-1	p-Xylene	3183.67347	2940	ug/L	9360	ug/mL
2	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/26/96	MW349-8	p-Xylene	3064.8855	2620	ug/L	8030	ug/mL
							Analyte Kfw avg	3047.43254				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	1,2,3-Trimethylbenzene	4049.29577	852	ug/L	3450	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	1,2,3-Trimethylbenzene	7648.22134	506	ug/L	3870	ug/mL
							Analyte Kfw avg	5848.75856				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	1,2,4-Trimethylbenzene	4582.04334	3230	ug/L	14800	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	1,2,4-Trimethylbenzene	8532.6087	1840	ug/L	15700	ug/mL
							Analyte Kfw avg	6557.32602				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	1,3,5-Trimethylbenzene	5136.09467	845	ug/L	4340	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	1,3,5-Trimethylbenzene	10340.1361	441	ug/L	4560	ug/mL
							Analyte Kfw avg	7738.11536				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	Naphthalene	3001.38313	723	ug/L	2170	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	Naphthalene	4632.5167	449	ug/L	2080	ug/mL
							Analyte Kfw avg	3816.94991				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	1-MethylNaphthalene	7482.9932	147	ug/L	1100	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	1-MethylNaphthalene	6617.64706	136	ug/L	900	ug/mL
							Analyte Kfw avg	7050.32013				
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-1FP	2-MethylNaphthalene	14430.3797	158	ug/L	2280	ug/mL
3	NRMRL	Tank 349, Offutt AFB, NE	Gasoline	06/01/90	06/23/97	MW-349-6FP	2-MethylNaphthalene	12739.726	146	ug/L	1860	ug/mL

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocId	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
							Analyte Kfw avg	13585.0529				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Benzene	802.825947	1557	ug/L	1250	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	Benzene	1157.89474	1425	ug/L	1650	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Benzene	265.549392	8473	ug/L	2250	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	Benzene	334.464372	4126	ug/L	1380	ug/mL
							Analyte Kfw avg	640.183612				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Toluene	1043.51032	2712	ug/L	2830	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	Toluene	2809.56447	1171	ug/L	3290	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Toluene	554.421769	8820	ug/L	4890	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	Toluene	1498.50746	1675	ug/L	2510	ug/mL
							Analyte Kfw avg	1476.50101				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Ethylbenzene	3041.8251	341.9	ug/L	1040	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	Ethylbenzene	4123.31407	259.5	ug/L	1070	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Ethylbenzene	1138.48768	1177	ug/L	1340	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	Ethylbenzene	2876.92308	325	ug/L	935	ug/mL
							Analyte Kfw avg	2795.13748				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	o-Xylene	2309.88593	1052	ug/L	2430	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	o-Xylene	3097.73676	790.9	ug/L	2450	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	o-Xylene	970.714051	3039	ug/L	2950	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	o-Xylene	2526.42706	946	ug/L	2390	ug/mL
							Analyte Kfw avg	2226.19095				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	m-Xylene	2646.15385	1300	ug/L	3440	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	m-Xylene	3589.16012	966.8	ug/L	3470	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	m-Xylene	1041.24748	3976	ug/L	4140	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	m-Xylene	3217.47766	1007	ug/L	3240	ug/mL
							Analyte Kfw avg	2623.50978				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	p-Xylene	3069.35333	426.8	ug/L	1310	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	p-Xylene	4130.64361	312.3	ug/L	1290	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	p-Xylene	1092.56449	1318	ug/L	1440	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	p-Xylene	2923.83292	407	ug/L	1190	ug/mL
							Analyte Kfw avg	2804.09859				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Total Xylenes	2583.84914	2778.8	ug/L	7180	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	Total Xylenes	3483.09179	2070	ug/L	7210	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Total Xylenes	1023.64095	8333	ug/L	8530	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	Total Xylenes	2889.83051	2360	ug/L	6820	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	1,2,3-Trimethylbenzene	5854.84474	534.6	ug/L	3130	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	1,2,3-Trimethylbenzene	7158.94869	399.5	ug/L	2860	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	1,2,3-Trimethylbenzene	1868.75	1600	ug/L	2990	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	1,2,3-Trimethylbenzene	7793.81443	485	ug/L	3780	ug/mL
							Analyte Kfw avg	5669.08947				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	1,2,4-Trimethylbenzene	7134.50292	1026	ug/L	7320	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	1,2,4-Trimethylbenzene	9188.29831	728.1	ug/L	6690	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	1,2,4-Trimethylbenzene	1980.16416	2924	ug/L	5790	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	1,2,4-Trimethylbenzene	7853.29018	927	ug/L	7280	ug/mL
							Analyte Kfw avg	6539.06389				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	1,3,5-Trimethylbenzene	7959.47902	276.4	ug/L	2200	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	1,3,5-Trimethylbenzene	10244.6483	196.2	ug/L	2010	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	1,3,5-Trimethylbenzene	3951.89003	873	ug/L	3450	ug/mL

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocid	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	1,3,5-Trimethylbenzene	15807.6923	260	ug/L	4110	ug/mL
							Analyte Kfw avg	9490.92742				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	Naphthalene	3336.70374	395.6	ug/L	1320	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	Naphthalene	3860.6403	318.6	ug/L	1230	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	Naphthalene	1172.77487	955	ug/L	1120	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	Naphthalene	4528.30189	318	ug/L	1440	ug/mL
							Analyte Kfw avg	3224.6052				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	1-MethylNaphthalene	8788.28229	150.2	ug/L	1320	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	1-MethylNaphthalene	8645.53314	138.8	ug/L	1200	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	1-MethylNaphthalene	1513.82824	687	ug/L	1040	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	1-MethylNaphthalene	7789.47368	190	ug/L	1480	ug/mL
							Analyte Kfw avg	6684.27934				
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-2	2-MethylNaphthalene	10333.4899	212.9	ug/L	2200	ug/mL
2	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/11/98	SH98-1610-3	2-MethylNaphthalene	10107.1975	195.9	ug/L	1980	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-2	2-MethylNaphthalene	2814.07035	597	ug/L	1680	ug/mL
1	NRMRL	Bldg 1610, Shaw AFB, SC	JP-4	06/01/94	03/06/97	SHMW1610-3	2-MethylNaphthalene	14821.4286	168	ug/L	2490	ug/mL
							Analyte Kfw avg	9519.04659				
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	Benzene	169.277108	332	ug/L	56.2	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	Toluene	2228	2.5	ug/L	5.57	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	Ethylbenzene	7761.96636	77.3	ug/L	600	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	o-Xylene	3837.83784	3.7	ug/L	14.2	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	m-Xylene	36345.3815	49.8	ug/L	1810	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	p-Xylene	76341.4634	4.1	ug/L	313	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	Total Xylenes	37104.1667	57.6	ug/L	2137.2	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	1,2,3-Trimethylbenzene	33074.3618	90.1	ug/L	2980	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	1,2,4-Trimethylbenzene	31100.4785	209	ug/L	6500	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	1,3,5-Trimethylbenzene	84023.6686	33.8	ug/L	2840	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	Naphthalene	7193.54839	124	ug/L	892	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	1-MethylNaphthalene	5116.27907	258	ug/L	1320	ug/mL
1	NRMRL	Pipeline Leak Site, Myrtle Beach AFB, SC	JP-4	01/01/81	03/04/97	MBMW24	2-MethylNaphthalene	9141.41414	198	ug/L	1810	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Benzene	0.67750678	36.9	ug/L	0.025	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Toluene	230.769231	884	ug/L	204	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Ethylbenzene	1600	535	ug/L	856	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	o-Xylene	2702.7027	370	ug/L	1000	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	m-Xylene	2552.52101	952	ug/L	2430	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	p-Xylene	1943.7751	498	ug/L	968	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Total Xylenes	2416.48352	1820	ug/L	4398	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	1,2,3-Trimethylbenzene	7111.9403	134	ug/L	953	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	1,2,4-Trimethylbenzene	7465.75342	292	ug/L	2180	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	1,3,5-Trimethylbenzene	12530.1205	83	ug/L	1040	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	Naphthalene	3324.50331	151	ug/L	502	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	1-MethylNaphthalene	10218.9781	137	ug/L	1400	ug/mL
3	NRMRL	DFSP-Charleston, Tank 1 Area, Hanahan, SC	JP-4	10/01/75	05/16/97	CH-MW-103	2-MethylNaphthalene	17821.7822	101	ug/L	1800	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	Benzene	47.6190476	56.7	ug/L	2.7	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Benzene	103.686636	8680	ug/L	900	ug/mL
							Analyte Kfw avg	75.6528418				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	Toluene	10.8695652	2.3	ug/L	0.025	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Toluene	9.25925926	2.7	ug/L	0.025	ug/mL
							Analyte Kfw avg	10.0644122				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	Ethylbenzene	4428.57143	560	ug/L	2480	ug/mL

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocid	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Ethylbenzene	4204.54545	704	ug/L	2960	ug/mL
							Analyte Kfw avg	4316.55844				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	o-Xylene	2883.95904	586	ug/L	1690	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	o-Xylene	9486.16601	253	ug/L	2400	ug/mL
							Analyte Kfw avg	6185.06253				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	m-Xylene	2663.31658	199	ug/L	530	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	m-Xylene	5404.74741	1643	ug/L	8880	ug/mL
							Analyte Kfw avg	4034.032				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	p-Xylene	4138.41808	708	ug/L	2930	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	p-Xylene	5080.14797	811	ug/L	4120	ug/mL
							Analyte Kfw avg	4609.28302				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	Total Xylenes	3449.43068	1493	ug/L	5150	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Total Xylenes	5688.95456	2707	ug/L	15400	ug/mL
							Analyte Kfw avg	4569.19262				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	1,2,3-Trimethylbenzene	10156.25	192	ug/L	1950	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	1,2,3-Trimethylbenzene	12932.3308	266	ug/L	3440	ug/mL
							Analyte Kfw avg	11544.2904				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	1,2,4-Trimethylbenzene	13257.4431	571	ug/L	7570	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	1,2,4-Trimethylbenzene	15302.5478	628	ug/L	9610	ug/mL
							Analyte Kfw avg	14279.9954				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	1,3,5-Trimethylbenzene	12604.7904	334	ug/L	4210	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	1,3,5-Trimethylbenzene	15859.8726	314	ug/L	4980	ug/mL
							Analyte Kfw avg	14232.3315				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	Naphthalene	6521.73913	161	ug/L	1050	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	Naphthalene	7633.587[illegible]	131	ug/L	1000	ug/mL
							Analyte Kfw avg	7077.66346				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	1-MethylNaphthalene	18859.6491	114	ug/L	2150	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	1-MethylNaphthalene	23781.3885	67.7	ug/L	1610	ug/mL
							Analyte Kfw avg	21320.5188				
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW306-FP	2-MethylNaphthalene	21823.2044	181	ug/L	3950	ug/mL
1	NRMRL	Spill Site No. 2, Eaker AFB, AR	JP-4	10/01/73	08/27/97	EAKMW316-FP	2-MethylNaphthalene	30176.8991	96.1	ug/L	2900	ug/mL
							Analyte Kfw avg	26000.0517				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Benzene	637.142857	3.5	ug/L	2.23	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Benzene	45.4175153	49.1	ug/L	2.23	ug/mL
							Analyte Kfw avg	341.280186				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Toluene	118.181818	110	ug/L	13	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Toluene	572.687225	22.7	ug/L	13	ug/mL
							Analyte Kfw avg	345.434521				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Ethylbenzene	958.677686	121	ug/L	116	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Ethylbenzene	563.106796	206	ug/L	116	ug/mL
							Analyte Kfw avg	760.892241				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	o-Xylene	1630.68182	176	ug/L	287	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	o-Xylene	934.85342	307	ug/L	287	ug/mL
							Analyte Kfw avg	1282.76762				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	m-Xylene	1103.44828	203	ug/L	224	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	m-Xylene	746.666667	300	ug/L	224	ug/mL
							Analyte Kfw avg	925.057471				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	p-Xylene	1443.47826	69	ug/L	99.6	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	p-Xylene	1048.42105	95	ug/L	99.6	ug/mL
							Analyte Kfw avg	1245.94966				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1,2,3-Trimethylbenzene	3379.72167	503	ug/L	1700	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1,2,3-Trimethylbenzene	3695.65217	460	ug/L	1700	ug/mL

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocId	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
							Analyte Kfw avg	3537.68692				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1,2,4-Trimethylbenzene	3264.65927	631	ug/L	2060	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1,2,4-Trimethylbenzene	3450.58626	597	ug/L	2060	ug/mL
							Analyte Kfw avg	3357.62277				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1,3,5-Trimethylbenzene	6793.65079	126	ug/L	856	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1,3,5-Trimethylbenzene	7575.22124	113	ug/L	856	ug/mL
							Analyte Kfw avg	7184.43602				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Naphthalene	1654.54545	275	ug/L	455	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	Naphthalene	1472.49191	309	ug/L	455	ug/mL
							Analyte Kfw avg	1563.51868				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1-MethylNaphthalene	6000	215	ug/L	1290	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	1-MethylNaphthalene	5512.82051	234	ug/L	1290	ug/mL
							Analyte Kfw avg	5756.41026				
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	2-MethylNaphthalene	8720.93023	172	ug/L	1500	ug/mL
1	NRMRL	Tank Farm C, Beaufort MCAS, SC	JP-5	06/01/90	08/12/97	BFT-401-3	2-MethylNaphthalene	7936.50794	189	ug/L	1500	ug/mL
							Analyte Kfw avg	8328.71908				
		GROUNDWATER DATA BASE REPORT DID NOT INCLUDE DATA FOR CECIL FIELD										
		DATA BELOW ENTERED BY HAND										
	NRMRL	Facility 293, Cecil Field NAS, FL	JP-5	06/01/81	05/20/97	CEF-293-9FP	Benzene	261.111111	90	ug/L	23.5	ug/mL
							Toluene	151.552795	805	ug/L	122	ug/mL
							Ethylbenzene	2669.49153	944	ug/L	2520	ug/mL
							o-Xylene	635.270541	499	ug/L	317	ug/mL
							m-Xylene	1866.66667	1500	ug/L	2800	ug/mL
							p-Xylene	2220.74468	752	ug/L	1670	ug/mL
							Total xylenes	1740.09451	2751	ug/L	4787	ug/mL
							1,2,3-TMB	6549.29577	284	ug/L	1860	ug/mL
							1,2,4-TMB	6896.55172	580	ug/L	4000	ug/mL
							1,3,5-TMB	7734.80663	181	ug/L	1400	ug/mL
							Naphthalene	6787.00361	277	ug/L	1880	ug/mL
							1-Methylnaphthalene	12722.2222	180	ug/L	2290	ug/mL
							2-Methylnaphthalene	21419.3548	155	ug/L	3320	ug/mL
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	Benzene	58.7034814	833	ug/L	48.9	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Benzene	228.773585	848	ug/L	194	ug/mL
							Analyte Kfw avg	143.738533				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	Toluene	220.303867	2896	ug/L	638	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Toluene	251.219512	4100	ug/L	1030	ug/mL
							Analyte Kfw avg	235.76169				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	Ethylbenzene	1448.04089	587	ug/L	850	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Ethylbenzene	1389.54869	842	ug/L	1170	ug/mL
							Analyte Kfw avg	1418.79479				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	o-Xylene	1458.99054	760.8	ug/L	1110	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	o-Xylene	1860.46512	946	ug/L	1760	ug/mL
							Analyte Kfw avg	1659.72783				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	m-Xylene	1165.12346	1296	ug/L	1510	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	m-Xylene	1890.90909	1650	ug/L	3120	ug/mL
							Analyte Kfw avg	1528.01627				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	p-Xylene	1360.91954	435	ug/L	592	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	p-Xylene	1728.97196	642	ug/L	1110	ug/mL
							Analyte Kfw avg	1544.94575				
		Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	Total xylenes	1289.02801	2491.8	ug/L	3212	ug/mL

Event	Lab Code	Site Name	Fuel Type	Spill Date	Date	FPLocid	Analyte	Kfw	GW Results	GW UNITS	FP Results	Units
		Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Total xylenes	1849.90735	3238	ug/L	5990	ug/mL
							Analyte Kfw avg	1569.46768				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	1,2,3-Trimethylbenzene	6075.6193	383.5	ug/L	2330	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	1,2,3-Trimethylbenzene	6340.32634	429	ug/L	2720	ug/mL
							Analyte Kfw avg	6207.97282				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	1,2,4-Trimethylbenzene	6281.371	697.3	ug/L	4380	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	1,2,4-Trimethylbenzene	7269.18075	769	ug/L	5590	ug/mL
							Analyte Kfw avg	6775.27588				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	1,3,5-Trimethylbenzene	6284.15301	183	ug/L	1150	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	1,3,5-Trimethylbenzene	8108.10811	259	ug/L	2100	ug/mL
							Analyte Kfw avg	7196.13056				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	Naphthalene	3557.26427	247.1	ug/L	879	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	Naphthalene	5039.37008	254	ug/L	1280	ug/mL
							Analyte Kfw avg	4298.31717				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	1-MethylNaphthalene	11759.3437	109.7	ug/L	1290	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	1-MethylNaphthalene	9496.85535	159	ug/L	1510	ug/mL
							Analyte Kfw avg	10628.0995				
4	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	03/10/98	SJ98-MP2	2-MethylNaphthalene	13361.4627	142.2	ug/L	1900	ug/mL
3	NRMRL	Bldg 4522, Seymour Johnson AFB, SC	JP-8	12/01/95	05/15/97	SJMW1SFP	2-MethylNaphthalene	16962.963	135	ug/L	2290	ug/mL
							Analyte Kfw avg	15162.2128				
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Benzene	50	0.5	ug/L	0.025	ug/mL
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Benzene	50	0.5	ug/L	0.025	ug/mL
							Analyte Kfw avg	50				
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Toluene	1.25	20	ug/L	0.025	ug/mL
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Toluene	25	1	ug/L	0.025	ug/mL
							Analyte Kfw avg	13.125				
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Ethylbenzene	9000	7	ug/L	63	ug/mL
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Ethylbenzene	1968.75	32	ug/L	63	ug/mL
							Analyte Kfw avg	5484.375				
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	o-Xylene	13727.2727	33	ug/L	453	ug/mL
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	o-Xylene	4768.42105	95	ug/L	453	ug/mL
							Analyte Kfw avg	9247.84689				
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Total Xylenes (m,p, and o)	3988.09524	252	ug/L	1005	ug/mL
1	NRMRL	JP-8 Release Site, Pope AFB, NC	JP-8	04/01/96	07/17/96	SOURCE AREA	Total Xylenes (m,p, and o)	15000	67	ug/L	1005	ug/mL
							Analyte Kfw avg	9494.04762				

APPENDIX C-3

RESIDUAL LNAPL CALCULATIONS

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	Benzene	42.8	mg/kg	B/FC	0.02172589	MW349-1	738000	ug/mL	16034
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	Toluene	105	mg/kg	T/FC	0.05329949	MW349-1	738000	ug/mL	39335
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	Ethylbenzene	24.4	mg/kg	E/FC	0.01238579	MW349-1	738000	ug/mL	9141
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	m-Xylene	42.4	mg/kg	m-Xylene/FC	0.02152284	MW349-1	738000	ug/mL	15884
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	o-Xylene	24.3	mg/kg	o-Xylene/FC	0.01233503	MW349-1	738000	ug/mL	9103
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	p-Xylene	19.3	mg/kg	p-Xylene/FC	0.00979695	MW349-1	738000	ug/mL	7230
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	Total Xylenes (m,p, and o)	86	mg/kg	X/FC	0.04365482	MW349-1	738000	ug/mL	32217
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	Total BTEX	258.2	mg/kg	BTEX/FC	0.13106599	MW349-1	738000	ug/mL	96727
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	B+T	147.8	mg/kg	(B+T)/FC	0.07502538	MW349-1	738000	ug/mL	55369
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	E+X	110.4	mg/kg	(E+X)/FC	0.05604061	MW349-1	738000	ug/mL	41358
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	B/T	0.407619		(B/T)/FC	0.00020691	MW349-1	738000	ug/mL	153
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	B/E	1.7540984		(B/E)/FC	0.00089041	MW349-1	738000	ug/mL	657
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	B/X	0.4976744		(B/X)/FC	0.00025263	MW349-1	738000	ug/mL	186
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	T/E	4.3032787		(T/E)/FC	0.00218441	MW349-1	738000	ug/mL	1612
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	T/X	1.2209302		(T/X)/FC	0.00061976	MW349-1	738000	ug/mL	457
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	E/X	0.2837209		(E/X)/FC	0.00014402	MW349-1	738000	ug/mL	106
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	(B+T)/(E+X)	1.3387681		((B+T)/(E+X))/FC	0.00067958	MW349-1	738000	ug/mL	502
NRMRL	Gasoline	6/1/90	9/23/94	Tank 349, Offutt AFB, NE	Soil	CPT1-39.5	Fuel Carbon	1970	mg/kg	Fuel Carbon	1	MW349-1	738000	ug/mL	738000
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	Benzene	0.562	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	Toluene	0.334	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	Ethylbenzene	0.291	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	m-Xylene	0.42	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	o-Xylene	0.147	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	p-Xylene	0.224	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	Total Xylenes (m,p, and o)	0.791	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	Total BTEX	1.978	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	B+T	0.896	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	E+X	1.082	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	B/T	1.6826347							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	B/E	1.9312715							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	B/X	0.710493							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	T/E	1.1477663							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	T/X	0.4222503							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	E/X	0.3678887							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	(B+T)/(E+X)	0.8280961							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	1,2,3-Trimethylbenzene	0.044	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	1,2,4-Trimethylbenzene	0.295	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	1,3,5-Trimethylbenzene	0.106	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	1-MethylNaphthalene	0.0118	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-39'	2-MethylNaphthalene	0.0315	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	Benzene	40.2	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	Toluene	165	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	Ethylbenzene	58.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	m-Xylene	99.8	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	o-Xylene	55.2	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	p-Xylene	48	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	Total Xylenes (m,p, and o)	203	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	Total BTEX	466.9	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	B+T	205.2	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	E+X	261.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	B/T	0.2436364							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	B/E	0.6848382							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	B/X	0.1980296							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	T/E	2.8109029							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	T/X	0.8128079							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	E/X	0.2891626							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	(B+T)/(E+X)	0.7841039							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	1,2,3-Trimethylbenzene	17.6	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	1,2,4-Trimethylbenzene	66	mg/kg						

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	1,3,5-Trimethylbenzene	22.3	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	1-MethylNaphthalene	5.59	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-1-40'	2-MethylNaphthalene	11.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	Benzene	19.2	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	Toluene	83.2	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	Ethylbenzene	37	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	m-Xylene	58.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	o-Xylene	32.9	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	p-Xylene	28.1	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	Total Xylenes (m,p, and o)	119.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	Total BTEX	259.1	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	B+T	102.4	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	E+X	156.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	B/T	0.2307692							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	B/E	0.5189189							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	B/X	0.160401							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	T/E	2.2486486							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	T/X	0.695071							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	E/X	0.3091061							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	(B+T)/(E+X)	0.653478							
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	1,2,3-Trimethylbenzene	11.7	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	1,2,4-Trimethylbenzene	45.6	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	1,3,5-Trimethylbenzene	14	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	1-MethylNaphthalene	2.63	mg/kg						
NRMRL	Gasoline	6/1/90	6/23/97	Tank 349, Offutt AFB, NE	Soil	OFSB-2-39'	2-MethylNaphthalene	5.36	mg/kg						

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	Benzene	0.331	mg/kg	B/FC	0.00013	SH98-1610-2	780000	ug/mL	101
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	Toluene	0.551	mg/kg	T/FC	0.00022	SH98-1610-2	780000	ug/mL	168
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	Ethylbenzene	1.84	mg/kg	E/FC	0.00072	SH98-1610-2	780000	ug/mL	561
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	m-Xylene	5.11	mg/kg	m-Xylene/FC	0.002	SH98-1610-2	780000	ug/mL	1557
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	o-Xylene	1.86	mg/kg	o-Xylene/FC	0.00073	SH98-1610-2	780000	ug/mL	567
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	p-Xylene	1.85	mg/kg	p-Xylene/FC	0.00072	SH98-1610-2	780000	ug/mL	564
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	Total Xylenes (m,p, and o)	8.82	mg/kg	X/FC	0.00345	SH98-1610-2	780000	ug/mL	2687
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	Total BTEX	11.542	mg/kg	BTEX/FC	0.00451	SH98-1610-2	780000	ug/mL	3517
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	B+T	0.882	mg/kg	(B+T)/FC	0.00034	SH98-1610-2	780000	ug/mL	269
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	E+X	10.66	mg/kg	(E+X)/FC	0.00416	SH98-1610-2	780000	ug/mL	3248
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	B/T	0.600726		(B/T)/FC	0.00023	SH98-1610-2	780000	ug/mL	183
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	B/E	0.1798913		(B/E)/FC	7E-05	SH98-1610-2	780000	ug/mL	55
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	B/X	0.0375283		(B/X)/FC	1.5E-05	SH98-1610-2	780000	ug/mL	11
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	T/E	0.2994565		(T/E)/FC	0.00012	SH98-1610-2	780000	ug/mL	91
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	T/X	0.0624717		(T/X)/FC	2.4E-05	SH98-1610-2	780000	ug/mL	19
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	E/X	0.2086168		(E/X)/FC	8.1E-05	SH98-1610-2	780000	ug/mL	63
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	(B+T)/(E+X)	0.0827392		((B+T)/(E+X))/FC	3.2E-05	SH98-1610-2	780000	ug/mL	25
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	Fuel Carbon	2560	mg/kg	Fuel Carbon	1	SH98-1610-2	780000	ug/mL	780000
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	1,2,3-Trimethylbenzene	3.38	mg/kg	1,2,3 TMB/FC	0.00132	SH98-1610-2	780000	ug/mL	1030
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	1,2,4-Trimethylbenzene	11.5	mg/kg	1,2,4 TMB/FC	0.00449	SH98-1610-2	780000	ug/mL	3504
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	1,3,5-Trimethylbenzene	4.83	mg/kg	1,3,5 TMB/FC	0.00189	SH98-1610-2	780000	ug/mL	1472
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	1-MethylNaphthalene	0.789	mg/kg	1-MN/FC	0.00031	SH98-1610-2	780000	ug/mL	240
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB1-27	2-MethylNaphthalene	1.5	mg/kg	2-MN/FC	0.00059	SH98-1610-2	780000	ug/mL	457
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	Benzene	0.394	mg/kg	B/FC	0.00015	SH98-1610-3	777000	ug/mL	116
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	Toluene	0.335	mg/kg	T/FC	0.00013	SH98-1610-3	777000	ug/mL	99
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	Ethylbenzene	3.9	mg/kg	E/FC	0.00148	SH98-1610-3	777000	ug/mL	1148
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	m-Xylene	12.5	mg/kg	m-Xylene/FC	0.00473	SH98-1610-3	777000	ug/mL	3679
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	o-Xylene	7.18	mg/kg	o-Xylene/FC	0.00272	SH98-1610-3	777000	ug/mL	2113
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	p-Xylene	4.43	mg/kg	p-Xylene/FC	0.00168	SH98-1610-3	777000	ug/mL	1304
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	Total Xylenes (m,p, and o)	24.11	mg/kg	X/FC	0.00913	SH98-1610-3	777000	ug/mL	7096
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	Total BTEX	28.739	mg/kg	BTEX/FC	0.01089	SH98-1610-3	777000	ug/mL	8458
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	B+T	0.729	mg/kg	(B+T)/FC	0.00028	SH98-1610-3	777000	ug/mL	215
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	E+X	28.01	mg/kg	(E+X)/FC	0.01061	SH98-1610-3	777000	ug/mL	8244
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	B/T	1.1761194		(B/T)/FC	0.00045	SH98-1610-3	777000	ug/mL	346
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	B/E	0.1010256		(B/E)/FC	3.8E-05	SH98-1610-3	777000	ug/mL	30
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	B/X	0.0163418		(B/X)/FC	6.2E-06	SH98-1610-3	777000	ug/mL	5
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	T/E	0.0858974		(T/E)/FC	3.3E-05	SH98-1610-3	777000	ug/mL	25
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	T/X	0.0138946		(T/X)/FC	5.3E-06	SH98-1610-3	777000	ug/mL	4
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	E/X	0.1617586		(E/X)/FC	6.1E-05	SH98-1610-3	777000	ug/mL	48
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	(B+T)/(E+X)	0.0260264		((B+T)/(E+X))/FC	9.9E-06	SH98-1610-3	777000	ug/mL	8
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	Fuel Carbon	2640	mg/kg	Fuel Carbon	1	SH98-1610-3	777000	ug/mL	777000
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	1,2,3-Trimethylbenzene	10.3	mg/kg	1,2,3 TMB/FC	0.0039	SH98-1610-3	777000	ug/mL	3031
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	1,2,4-Trimethylbenzene	24.7	mg/kg	1,2,4 TMB/FC	0.00936	SH98-1610-3	777000	ug/mL	7270
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	1,3,5-Trimethylbenzene	7.8	mg/kg	1,3,5 TMB/FC	0.00295	SH98-1610-3	777000	ug/mL	2296
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	1-MethylNaphthalene	4.42	mg/kg	1-MN/FC	0.00167	SH98-1610-3	777000	ug/mL	1301
NRMRL	JP-4	6/1/94	3/11/98	Bldg 1610, Shaw AFB, SC	Soil	SH98-SB2-27	2-MethylNaphthalene	7.11	mg/kg	2-MN/FC	0.00269	SH98-1610-3	777000	ug/mL	2093
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	Benzene	0.544	mg/kg	B/FC	0.00291	SHMW1610-2	765000	ug/mL	2225
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	Toluene	0.787	mg/kg	T/FC	0.00421	SHMW1610-2	765000	ug/mL	3220
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	Ethylbenzene	0.224	mg/kg	E/FC	0.0012	SHMW1610-2	765000	ug/mL	916
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	m-Xylene	0.78	mg/kg	m-Xylene/FC	0.00417	SHMW1610-2	765000	ug/mL	3191
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	o-Xylene	0.581	mg/kg	o-Xylene/FC	0.00311	SHMW1610-2	765000	ug/mL	2377
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	p-Xylene	0.257	mg/kg	p-Xylene/FC	0.00137	SHMW1610-2	765000	ug/mL	1051
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	Total Xylenes (m,p, and o)	1.618	mg/kg	X/FC	0.00865	SHMW1610-2	765000	ug/mL	6619
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	Total BTEX	3.173	mg/kg	BTEX/FC	0.01697	SHMW1610-2	765000	ug/mL	12980
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	B+T	1.331	mg/kg	(B+T)/FC	0.00712	SHMW1610-2	765000	ug/mL	5445
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	E+X	1.842	mg/kg	(E+X)/FC	0.00985	SHMW1610-2	765000	ug/mL	7535
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	B/T	0.6912325		(B/T)/FC	0.0037	SHMW1610-2	765000	ug/mL	2828
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	B/E	2.4285714		(B/E)/FC	0.01299	SHMW1610-2	765000	ug/mL	9935
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	B/X	0.3362176		(B/X)/FC	0.0018	SHMW1610-2	765000	ug/mL	1375
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	T/E	3.5133929		(T/E)/FC	0.01879	SHMW1610-2	765000	ug/mL	14373

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	T/X	0.486403		(T/X)/FC	0.0026	SHMW1610-2	765000	ug/mL	1990
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	E/X	0.1384425		(E/X)/FC	0.00074	SHMW1610-2	765000	ug/mL	566
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	(B+T)/(E+X)	0.7225841		((B+T)/(E+X))/FC	0.00386	SHMW1610-2	765000	ug/mL	2956
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	Fuel Carbon	187	mg/kg	Fuel Carbon	1	SHMW1610-2	765000	ug/mL	765000
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	1,2,3-Trimethylbenzene	0.919	mg/kg	1,2,3 TMB/FC	0.00491	SHMW1610-2	765000	ug/mL	3760
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	1,2,4-Trimethylbenzene	1.74	mg/kg	1,2,4 TMB/FC	0.0093	SHMW1610-2	765000	ug/mL	7118
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	1,3,5-Trimethylbenzene	0.527	mg/kg	1,3,5 TMB/FC	0.00282	SHMW1610-2	765000	ug/mL	21[illegible]
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	1-MethylNaphthalene	0.456	mg/kg	1-MN/FC	0.00244	SHMW1610-2	765000	ug/mL	1865
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-1-33'	2-MethylNaphthalene	0.72	mg/kg	2-MN/FC	0.00385	SHMW1610-2	765000	ug/mL	2945
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	Benzene	5.08	mg/kg	B/FC	0.00212	SHMW1610-3	783000	ug/mL	1657
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	Toluene	10.8	mg/kg	T/FC	0.0045	SHMW1610-3	783000	ug/mL	3524
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	Ethylbenzene	3.58	mg/kg	E/FC	0.00149	SHMW1610-3	783000	ug/mL	1168
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	m-Xylene	12.2	mg/kg	m-Xylene/FC	0.00508	SHMW1610-3	783000	ug/mL	3980
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	o-Xylene	8.92	mg/kg	o-Xylene/FC	0.00372	SHMW1610-3	783000	ug/mL	2910
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	p-Xylene	4.17	mg/kg	p-Xylene/FC	0.00174	SHMW1610-3	783000	ug/mL	1360
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	Tc [illegible]lenes (m,p, and o)	25.29	mg/kg	X/FC	0.01054	SHMW1610-3	783000	ug/mL	8251
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	Total BTEX	44.75	mg/kg	BTEX/FC	0.01865	SHMW1610-3	783000	ug/mL	14600
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	B+T	15.88	mg/kg	(B+T)/FC	0.00662	SHMW1610-3	783000	ug/mL	5181
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	E+X	28.87	mg/kg	(E+X)/FC	0.01203	SHMW1610-3	783000	ug/mL	9419
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	B/T	0.4703704		(B/T)/FC	0.0002	SHMW1610-3	783000	ug/mL	153
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	B/E	1.4189944		(B/E)/FC	0.00059	SHMW1610-3	783000	ug/mL	463
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	B/X	0.2008699		(B/X)/FC	8.4E-05	SHMW1610-3	783000	ug/mL	66
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	T/E	3.0167598		(T/E)/FC	0.00126	SHMW1610-3	783000	ug/mL	984
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	T/X	0.4270463		(T/X)/FC	0.00018	SHMW1610-3	783000	ug/mL	139
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	E/X	0.1415579		(E/X)/FC	5.9E-05	SHMW1610-3	783000	ug/mL	46
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	(B+T)/(E+X)	0.550052		((B+T)/(E+X))/FC	0.00023	SHMW1610-3	783000	ug/mL	179
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	Fuel Carbon	2400	mg/kg	Fuel Carbon	1	SHMW1610-3	783000	ug/mL	783000
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	1,2,3-Trimethylbenzene	13.3	mg/kg	1,2,3 TMB/FC	0.00554	SHMW1610-3	783000	ug/mL	4339
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	1,2,4-Trimethylbenzene	25.2	mg/kg	1,2,4 TMB/FC	0.0105	SHMW1610-3	783000	ug/mL	82[illegible]
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	1,3,5-Trimethylbenzene	13.5	mg/kg	1,3,5 TMB/FC	0.00563	SHMW1610-3	783000	ug/mL	4404
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	1-MethylNaphthalene	5.31	mg/kg	1-MN/FC	0.00221	SHMW1610-3	783000	ug/mL	1732
NRMRL	JP-4	6/1/94	3/5/97	Bldg 1610, Shaw AFB, SC	Soil	SHSB-2-33'	2-MethylNaphthalene	8.72	mg/kg	2-MN/FC	0.00363	SHMW1610-3	783000	ug/mL	2845
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	Benzene	0.006	mg/kg	B/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	Toluene	0.0173	mg/kg	[illegible]	2.88333	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	Ethylbenzene	0.006	mg/kg	E/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	m-Xylene	0.006	mg/kg	m-Xylene/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	o-Xylene	0.006	mg/kg	o-Xylene/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	p-Xylene	0.006	mg/kg	p-Xylene/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	Total Xylenes (m,p, and o)	0.018	mg/kg	X/FC	3	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	Total BTEX	0.0473	mg/kg	BTEX/FC	7.88333	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	B+T	0.0233	mg/kg	(B+T)/FC	3.88333	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	E+X	0.024	mg/kg	(E+X)/FC	4	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	B/T	0.3468208		(B/T)/FC	57.8035	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	B/E	1		(B/E)/FC	166.667	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	B/X	0.3333333		(B/X)/FC	55.5556	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	T/E	2.8833333		(T/E)/FC	480.556	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	T/X	0.9611111		(T/X)/FC	160.185	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	E/X	0.3333333		(E/X)/FC	55.5556	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	(B+T)/(E+X)	0.9708333		((B+T)/(E+X))/FC	161.806	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	Fuel Carbon	0.006	mg/kg	Fuel Carbon	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	1,2,3-Trimethylbenzene	0.006	mg/kg	1,2,3 TMB/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	1,2,4-Trimethylbenzene	0.006	mg/kg	1,2,4 TMB/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	1,3,5-Trimethylbenzene	0.006	mg/kg	1,3,5 TMB/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	1-MethylNaphthalene	0.006	mg/kg	1-MN/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB1-14.5'	2-MethylNaphthalene	0.006	mg/kg	2-MN/FC	1	CH-MW-103	760000	ug/mL	fuel carbon = nd
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	Benzene	0.0367	mg/kg	B/FC	0.00055	CH-EW6	796000	ug/mL	435
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	Toluene	0.0354	mg/kg	T/FC	0.00053	CH-EW6	796000	ug/mL	41[illegible]
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	Ethylbenzene	0.134	mg/kg	E/FC	0.00199	CH-EW6	796000	ug/mL	1587
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	m-Xylene	0.452	mg/kg	m-Xylene/FC	0.00673	CH-EW6	796000	ug/mL	5354
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	o-Xylene	0.152	mg/kg	o-Xylene/FC	0.00226	CH-EW6	796000	ug/mL	1800

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	p-Xylene	0.199	mg/kg	p-Xylene/FC	0.00296	CH-EW6	796000	ug/mL	2357
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	Total Xylenes (m,p, and o)	0.803	mg/kg	X/FC	0.01195	CH-EW6	796000	ug/mL	9512
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	Total BTEX	1.0091	mg/kg	BTEX/FC	0.01502	CH-EW6	796000	ug/mL	11953
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	B+T	0.0721	mg/kg	(B+T)/FC	0.00107	CH-EW6	796000	ug/mL	854
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	E+X	0.937	mg/kg	(E+X)/FC	0.01394	CH-EW6	796000	ug/mL	11099
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	B/T	1.0367232		(B/T)/FC	0.01543	CH-EW6	796000	ug/mL	12280
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	B/E	0.2738806		(B/E)/FC	0.00408	CH-EW6	796000	ug/mL	3244
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	B/X	0.0457036		(B/X)/FC	0.00068	CH-EW6	796000	ug/mL	541
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	T/E	0.2641791		(T/E)/FC	0.00393	CH-EW6	796000	ug/mL	3129
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	T/X	0.0440847		(T/X)/FC	0.00066	CH-EW6	796000	ug/mL	522
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	E/X	0.1668742		(E/X)/FC	0.00248	CH-EW6	796000	ug/mL	1977
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	(B+T)/(E+X)	0.0769477		((B+T)/(E+X))/FC	0.00115	CH-EW6	796000	ug/mL	911
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	Fuel Carbon	67.2	mg/kg	Fuel Carbon	1	CH-EW6	796000	ug/mL	796000
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	1,2,3-Trimethylbenzene	0.168	mg/kg	1,2,3 TMB/FC	0.0025	CH-EW6	796000	ug/mL	1990
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	1,2,4-Trimethylbenzene	0.331	mg/kg	1,2,4 TMB/FC	0.00493	CH-EW6	796000	ug/mL	3921
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	1,3,5-Trimethylbenzene	0.167	mg/kg	1,3,5 TMB/FC	0.00249	CH-EW6	796000	ug/mL	1978
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	1-MethylNaphthalene	0.189	mg/kg	1-MN/FC	0.00281	CH-EW6	796000	ug/mL	2239
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-12'	2-MethylNaphthalene	0.236	mg/kg	2-MN/FC	0.00351	CH-EW6	796000	ug/mL	2795
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	Benzene	1.05	mg/kg	B/FC	0.00011	CH-EW6	796000	ug/mL	85
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	Toluene	21.7	mg/kg	T/FC	0.00222	CH-EW6	796000	ug/mL	1764
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	Ethylbenzene	34.3	mg/kg	E/FC	0.0035	CH-EW6	796000	ug/mL	2789
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	m-Xylene	90	mg/kg	m-Xylene/FC	0.00919	CH-EW6	796000	ug/mL	7318
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	o-Xylene	45.2	mg/kg	o-Xylene/FC	0.00462	CH-EW6	796000	ug/mL	3675
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	p-Xylene	38	mg/kg	p-Xylene/FC	0.00388	CH-EW6	796000	ug/mL	3090
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	Total Xylenes (m,p, and o)	173.2	mg/kg	X/FC	0.01769	CH-EW6	796000	ug/mL	14082
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	Total BTEX	230.25	mg/kg	BTEX/FC	0.02352	CH-EW6	796000	ug/mL	18721
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	B+T	22.75	mg/kg	(B+T)/FC	0.00232	CH-EW6	796000	ug/mL	1850
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	E+X	207.5	mg/kg	(E+X)/FC	0.0212	CH-EW6	796000	ug/mL	16871
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	B/T	0.0483871		(B/T)/FC	4.9E-06	CH-EW6	796000	ug/mL	4
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	B/E	0.0306122		(B/E)/FC	3.1E-06	CH-EW6	796000	ug/mL	2
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	B/X	0.0060624		(B/X)/FC	6.2E-07	CH-EW6	796000	ug/mL	0
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	T/E	0.6326531		(T/E)/FC	6.5E-05	CH-EW6	796000	ug/mL	51
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	T/X	0.1252887		(T/X)/FC	1.3E-05	CH-EW6	796000	ug/mL	10
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	E/X	0.198037		(E/X)/FC	2E-05	CH-EW6	796000	ug/mL	16
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	(B+T)/(E+X)	0.1096386		((B+T)/(E+X))/FC	1.1E-05	CH-EW6	796000	ug/mL	9
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	Fuel Carbon	9790	mg/kg	Fuel Carbon	1	CH-EW6	796000	ug/mL	796000
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	1,2,3-Trimethylbenzene	21.4	mg/kg	1,2,3 TMB/FC	0.00219	CH-EW6	796000	ug/mL	1740
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	1,2,4-Trimethylbenzene	45.9	mg/kg	1,2,4 TMB/FC	0.00469	CH-EW6	796000	ug/mL	3732
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	1,3,5-Trimethylbenzene	21.7	mg/kg	1,3,5 TMB/FC	0.00222	CH-EW6	796000	ug/mL	1764
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	1-MethylNaphthalene	26.8	mg/kg	1-MN/FC	0.00274	CH-EW6	796000	ug/mL	2179
NRMRL	JP-4	10/1/75	5/16/97	DFSP-Charleston, Tank 1 Area, Hanahan, SC	Soil	CHSB2-13'	2-MethylNaphthalene	33.7	mg/kg	2-MN/FC	0.00344	CH-EW6	796000	ug/mL	2740
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	Benzene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	Toluene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	Ethylbenzene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	m-Xylene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	o-Xylene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	p-Xylene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	Total Xylenes (m,p, and o)	0.018	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	Total BTEX	0.036	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	B+T	0.012	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	E+X	0.024	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	B/T	1							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	B/E	1							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	B/X	0.3333333							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	T/E	1							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	T/X	0.3333333							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	E/X	0.3333333							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	(B+T)/(E+X)	0.5							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	1,2,3-Trimethylbenzene	0.0475	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	1,2,4-Trimethylbenzene	0.006	mg/kg						No FP/No FC data

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	1,3,5-Trimethylbenzene	0.28	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	1-MethylNaphthalene	0.117	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB4	2-MethylNaphthalene	0.144	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	Benzene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	Toluene	0.0855	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	Ethylbenzene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	m-Xylene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	o-Xylene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	p-Xylene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	Total Xylenes (m,p, and o)	0.018	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	Total BTEX	0.1155	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	B+T	0.0915	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	E+X	0.024	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	B/T	0.0701754							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	B/E	1							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	B/X	0.3333333							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	T/E	14.25							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	T/X	4.75							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	E/X	0.3333333							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	(B+T)/(E+X)	3.8125							No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	1,2,3-Trimethylbenzene	0.0514	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	1,2,4-Trimethylbenzene	0.006	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	1,3,5-Trimethylbenzene	0.3	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	1-MethylNaphthalene	0.118	mg/kg						No FP/No FC data
NRMRL	JP-4	10/1/88	8/6/96	KC-135 Crash Site, Wurtsmith AFB, MI	Soil	SB5	2-MethylNaphthalene	0.158	mg/kg						No FP/No FC data
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	Benzene	1.1	mg/kg	B/FC	0.00205	MBMW8I	750000	ug/mL	1536
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	Toluene	0.006	mg/kg	T/FC	1.1E-05	MBMW8I	750000	ug/mL	8
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	Ethylbenzene	2.38	mg/kg	E/FC	0.00443	MBMW8I	750000	ug/mL	3324
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	m-Xylene	5.69	mg/kg	m-Xylene/FC	0.0106	MBMW8I	750000	ug/mL	7947
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	o-Xylene	0.131	mg/kg	o-Xylene/FC	0.00024	MBMW8I	750000	ug/mL	183
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	p-Xylene	1.1	mg/kg	p-Xylene/FC	0.00205	MBMW8I	750000	ug/mL	1536
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	Total Xylenes (m,p, and o)	6.921	mg/kg	X/FC	0.01289	MBMW8I	750000	ug/mL	9666
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	Total BTEX	10.407	mg/kg	BTEX/FC	0.01938	MBMW8I	750000	ug/mL	14535
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	B+T	1.106	mg/kg	(B+T)/FC	0.00206	MBMW8I	750000	ug/mL	1545
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	E+X	9.301	mg/kg	(E+X)/FC	0.01732	MBMW8I	750000	ug/mL	12990
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	B/T	183.33333		(B/T)/FC	0.3414	MBMW8I	750000	ug/mL	256052
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	B/E	0.4621849		(B/E)/FC	0.00086	MBMW8I	750000	ug/mL	646
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	B/X	0.1589366		(B/X)/FC	0.0003	MBMW8I	750000	ug/mL	222
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	T/E	0.002521		(T/E)/FC	4.7E-06	MBMW8I	750000	ug/mL	4
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	T/X	0.0008669		(T/X)/FC	1.6E-06	MBMW8I	750000	ug/mL	1
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	E/X	0.3438809		(E/X)/FC	0.00064	MBMW8I	750000	ug/mL	480
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	(B+T)/(E+X)	0.1189119		((B+T)/(E+X))/FC	0.00022	MBMW8I	750000	ug/mL	166
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	Fuel Carbon	537	mg/kg	Fuel Carbon	1	MBMW8I	750000	ug/mL	750000
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	1,2,3-Trimethylbenzene	4.17	mg/kg	1,2,3 TMB/FC	0.00777	MBMW8I	750000	ug/mL	5824
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	1,2,4-Trimethylbenzene	9.66	mg/kg	1,2,4 TMB/FC	0.01799	MBMW8I	750000	ug/mL	13492
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	1,3,5-Trimethylbenzene	2.82	mg/kg	1,3,5 TMB/FC	0.00525	MBMW8I	750000	ug/mL	3939
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	1-MethylNaphthalene	2.71	mg/kg	1-MN/FC	0.00505	MBMW8I	750000	ug/mL	3785
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-1-9.5'	2-MethylNaphthalene	3.93	mg/kg	2-MN/FC	0.00732	MBMW8I	750000	ug/mL	5489
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	Benzene	[illegible]	mg/kg	B/FC	0.00062	MBMW24	764000	ug/mL	470
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	Toluene	0.0303	mg/kg	T/FC	1.1E-05	MBMW24	764000	ug/mL	8
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	Ethylbenzene	8.47	mg/kg	E/FC	0.00305	MBMW24	764000	ug/mL	2328
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	m-Xylene	10.9	mg/kg	m-Xylene/FC	0.00392	MBMW24	764000	ug/mL	2996
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	o-Xylene	0.0503	mg/kg	o-Xylene/FC	1.8E-05	MBMW24	764000	ug/mL	14
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	p-Xylene	0.497	mg/kg	p-Xylene/FC	0.00018	MBMW24	764000	ug/mL	137
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	Total Xylenes (m,p, and o)	11.4473	mg/kg	X/FC	0.00412	MBMW24	764000	ug/mL	3146
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	Total BTEX	21.6576	mg/kg	BTEX/FC	0.00779	MBMW24	764000	ug/mL	5952
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	B+T	1.7403	mg/kg	(B+T)/FC	0.00063	MBMW24	764000	ug/mL	478
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	E+X	19.9173	mg/kg	(E+X)/FC	0.00716	MBMW24	764000	ug/mL	5474
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	B/T	56.435644		(B/T)/FC	0.0203	MBMW24	764000	ug/mL	15510
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	B/E	0.201889		(B/E)/FC	7.3E-05	MBMW24	764000	ug/mL	55

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	B/X	0.1493802		(B/X)/FC	5.4E-05	MBMW24	764000	ug/mL	41
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	T/E	0.0035773		(T/E)/FC	1.3E-06	MBMW24	764000	ug/mL	1
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	T/X	0.0026469		(T/X)/FC	9.5E-07	MBMW24	764000	ug/mL	1
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	E/X	0.7399125		(E/X)/FC	0.00027	MBMW24	764000	ug/mL	203
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	(B+T)/(E+X)	0.0873763		((B+T)/(E+X))/FC	3.1E-05	MBMW24	764000	ug/mL	24
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	Fuel Carbon	2780	mg/kg	Fuel Carbon	1	MBMW24	764000	ug/mL	764000
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	1,2,3-Trimethylbenzene	14.7	mg/kg	1,2,3 TMB/FC	0.00529	MBMW24	764000	ug/mL	4040
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	1,2,4-Trimethylbenzene	36.4	mg/kg	1,2,4 TMB/FC	0.01309	MBMW24	764000	ug/mL	10003
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	1,3,5-Trimethylbenzene	9.51	mg/kg	1,3,5 TMB/FC	0.00342	MBMW24	764000	ug/mL	2614
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	1-MethylNaphthalene	7.62	mg/kg	1-MN/FC	0.00274	MBMW24	764000	ug/mL	2094
NRMRL	JP-4	1/1/81	3/4/97	Pipeline Leak Site, Myrtle Beach AFB, SC	Soil	MBSB-2-9.5'	2-MethylNaphthalene	11.5	mg/kg	2-MN/FC	0.00414	MBMW24	764000	ug/mL	3160
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	Benzene	10.8	mg/kg	B/FC	0.00345	EAKMW316-FP	770400	ug/mL	2658
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	Toluene	0.039	mg/kg	T/FC	1.2E-05	EAKMW316-FP	770400	ug/mL	10
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	Ethylbenzene	16.6	mg/kg	E/FC	0.0053	EAKMW316-FP	770400	ug/mL	4086
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	m-Xylene	43.7	mg/kg	m-Xylene/FC	0.01396	EAKMW316-FP	770400	ug/mL	10756
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	o-Xylene	17.5	mg/kg	o-Xylene/FC	0.00559	EAKMW316-FP	770400	ug/mL	4307
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	p-Xylene	20.1	mg/kg	p-Xylene/FC	0.00642	EAKMW316-FP	770400	ug/mL	4947
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	Total Xylenes (m,p, and o)	81.3	mg/kg	X/FC	0.02597	EAKMW316-FP	770400	ug/mL	20011
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	Total BTEX	108.739	mg/kg	BTEX/FC	0.03474	EAKMW316-FP	770400	ug/mL	26764
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	B+T	10.839	mg/kg	(B+T)/FC	0.00346	EAKMW316-FP	770400	ug/mL	2668
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	E+X	97.9	mg/kg	(E+X)/FC	0.03128	EAKMW316-FP	770400	ug/mL	24097
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	B/T	276.92308		(B/T)/FC	0.08847	EAKMW316-FP	770400	ug/mL	68160
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	B/E	0.6506024		(B/E)/FC	0.00021	EAKMW316-FP	770400	ug/mL	160
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	B/X	0.1328413		(B/X)/FC	4.2E-05	EAKMW316-FP	770400	ug/mL	33
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	T/E	0.0023494		(T/E)/FC	7.5E-07	EAKMW316-FP	770400	ug/mL	1
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	T/X	0.00047[illegible]		(T/X)/FC	1.5E-07	EAKMW316-FP	770400	ug/mL	0
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	E/X	0.204182		(E/X)/FC	6.5E-05	EAKMW316-FP	770400	ug/mL	50
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	(B+T)/(E+X)	0.110715		((B+T)/(E+X))/FC	3.5E-05	EAKMW316-FP	770400	ug/mL	27
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	Fuel Carbon	3130	mg/kg	Fuel Carbon	1	EAKMW316-FP	770400	ug/mL	770400
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	1,2,3-Trimethylbenzene	12.2	mg/kg	1,2,3 TMB/FC	0.0039	EAKMW316-FP	770400	ug/mL	3003
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	1,2,4-Trimethylbenzene	36.2	mg/kg	1,2,4 TMB/FC	0.01157	EAKMW316-FP	770400	ug/mL	8910
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	1,3,5-Trimethylbenzene	19.6	mg/kg	1,3,5 TMB/FC	0.00626	EAKMW316-FP	770400	ug/mL	4824
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	1-MethylNaphthalene	6.44	mg/kg	1-MN/FC	0.00206	EAKMW316-FP	770400	ug/mL	1585
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB1-3	2-MethylNaphthalene	11.[illegible]	mg/kg	2-MN/FC	0.00374	EAKMW316-FP	770400	ug/mL	2880
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	Benzene	0.006	mg/kg	B/FC	2.1E-05	EAKMW306-FP	762600	ug/mL	16
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	Toluene	0.006	mg/kg	T/FC	2.1E-05	EAKMW306-FP	762600	ug/mL	16
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	Ethylbenzene	0.265	mg/kg	E/FC	0.00091	EAKMW306-FP	762600	ug/mL	694
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	m-Xylene	0.006	mg/kg	m-Xylene/FC	2.1E-05	EAKMW306-FP	762600	ug/mL	16
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	o-Xylene	0.006	mg/kg	o-Xylene/FC	2.1E-05	EAKMW306-FP	762600	ug/mL	16
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	p-Xylene	0.193	mg/kg	p-Xylene/FC	0.00066	EAKMW306-FP	762600	ug/mL	506
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	Total Xylenes (m,p, and o)	0.20[illegible]	mg/kg	X/FC	0.0007	EAKMW306-FP	762600	ug/mL	537
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	Total BTEX	0.482	mg/kg	BTEX/FC	0.00166	EAKMW306-FP	762600	ug/mL	1263
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	B+T	0.012	mg/kg	(B+T)/FC	4.1E-05	EAKMW306-FP	762600	ug/mL	31
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	E+X	0.47	mg/kg	(E+X)/FC	0.00162	EAKMW306-FP	762600	ug/mL	1232
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	B/T	1		(B/T)/FC	0.00344	EAKMW306-FP	762600	ug/mL	2621
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	B/E	0.0226415		(B/E)/FC	7.8E-05	EAKMW306-FP	762600	ug/mL	59
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	B/X	0.0292683		(B/X)/FC	0.0001	EAKMW306-FP	762600	ug/mL	77
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	T/E	0.0226415		(T/E)/FC	7.8E-05	EAKMW306-FP	762600	ug/mL	59
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	T/X	0.029268[illegible]		(T/X)/FC	0.0001	EAKMW306-FP	762600	ug/mL	77
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	E/X	1.2926829		(E/X)/FC	0.00444	EAKMW306-FP	762600	ug/mL	3388
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	(B+T)/(E+X)	0.0255319		((B+T)/(E+X))/FC	8.8E-05	EAKMW306-FP	762600	ug/mL	67
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	Fuel Carbon	291	mg/kg	Fuel Carbon	1	EAKMW306-FP	762600	ug/mL	762600
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	1,2,3-Trimethylbenzene	0.682	mg/kg	1,2,3 TMB/FC	0.00234	EAKMW306-FP	762600	ug/mL	1787
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	1,2,4-Trimethylbenzene	1.99	mg/kg	1,2,4 TMB/FC	0.00684	EAKMW306-FP	762600	ug/mL	5215
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	1,3,5-Trimethylbenzene	0.692	mg/kg	1,3,5 TMB/FC	0.00238	EAKMW306-FP	762600	ug/mL	1813
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	1-MethylNaphthalene	0.535	mg/kg	1-MN/FC	0.00184	EAKMW306-FP	762600	ug/mL	1402
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-2	2-MethylNaphthalene	0.428	mg/kg	2-MN/FC	0.00147	EAKMW306-FP	762600	ug/mL	1122
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	Benzene	0.006	mg/kg	B/FC	3.7E-06	EAKMW306-FP	762600	ug/mL	3
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	Toluene	0.006	mg/kg	T/FC	3.7E-06	EAKMW306-FP	762600	ug/mL	3
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	Ethylbenzene	5.4	mg/kg	E/FC	0.00335	EAKMW306-FP	762600	ug/mL	2558

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	LocId	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocId	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	m-Xylene	0.877	mg/kg	m-Xylene/FC	0.00054	EAKMW306-FP	762600	ug/mL	415
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	o-Xylene	2.72	mg/kg	o-Xylene/FC	0.00169	EAKMW306-FP	762600	ug/mL	1288
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	p-Xylene	5.8	mg/kg	p-Xylene/FC	0.0036	EAKMW306-FP	762600	ug/mL	2747
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	Total Xylenes (m,p, and o)	9.397	mg/kg	X/FC	0.00584	EAKMW306-FP	762600	ug/mL	4451
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	Total BTEX	14.809	mg/kg	BTEX/FC	0.0092	EAKMW306-FP	762600	ug/mL	7014
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	B+T	0.012	mg/kg	(B+T)/FC	7.5E-06	EAKMW306-FP	762600	ug/mL	6
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	E+X	14.797	mg/kg	(E+X)/FC	0.00919	EAKMW306-FP	762600	ug/mL	7009
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	B/T	1		(B/T)/FC	0.00062	EAKMW306-FP	762600	ug/mL	474
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	B/E	0.0011111		(B/E)/FC	6.9E-07	EAKMW306-FP	762600	ug/mL	1
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	B/X	0.0006385		(B/X)/FC	4E-07	EAKMW306-FP	762600	ug/mL	0
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	T/E	0.0011111		(T/E)/FC	6.9E-07	EAKMW306-FP	762600	ug/mL	1
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	T/X	0.0006385		(T/X)/FC	4E-07	EAKMW306-FP	762600	ug/mL	0
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	E/X	0.5746515		(E/X)/FC	0.00036	EAKMW306-FP	762600	ug/mL	272
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	(B+T)/(E+X)	0.000811		((B+T)/(E+X))/FC	5E-07	EAKMW306-FP	762600	ug/mL	0
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	Fuel Carbon	1610	mg/kg	Fuel Carbon	1	EAKMW306-FP	762600	ug/mL	762600
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	1,2,3-Trimethylbenzene	4.09	mg/kg	1,2,3 TMB/FC	0.00254	EAKMW306-FP	762600	ug/mL	1937
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	1,2,4-Trimethylbenzene	14.1	mg/kg	1,2,4 TMB/FC	0.00876	EAKMW306-FP	762600	ug/mL	6679
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	1,3,5-Trimethylbenzene	7.66	mg/kg	1,3,5 TMB/FC	0.00476	EAKMW306-FP	762600	ug/mL	3628
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	1-MethylNaphthalene	3.74	mg/kg	1-MN/FC	0.00232	EAKMW306-FP	762600	ug/mL	1772
NRMRL	JP-4	10/1/73	8/27/97	Spill Site No. 2, Eaker AFB, AR	Soil	EAKSB2-4	2-MethylNaphthalene	6.71	mg/kg	2-MN/FC	0.00417	EAKMW306-FP	762600	ug/mL	3178

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	Benzene	0.0457	mg/kg	B/FC	9.44215E-06	BFT-401-3	804400	ug/mL	8
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	Toluene	0.56	mg/kg	T/FC	0.000115702	BFT-401-3	804400	ug/mL	93
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	Ethylbenzene	3.35	mg/kg	E/FC	0.000692149	BFT-401-3	804400	ug/mL	557
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	m-Xylene	5.02	mg/kg	m-Xylene/FC	0.00103719	BFT-401-3	804400	ug/mL	834
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	o-Xylene	3.95	mg/kg	o-Xylene/FC	0.000816116	BFT-401-3	804400	ug/mL	656
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	p-Xylene	1.98	mg/kg	p-Xylene/FC	0.000409091	BFT-401-3	804400	ug/mL	329
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	Total Xylenes (m,p, and o)	10.95	mg/kg	X/FC	0.002262397	BFT-401-3	804400	ug/mL	1820
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	Total BTEX	14.9057	mg/kg	BTEX/FC	0.00307969	BFT-401-3	804400	ug/mL	2477
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	B+T	0.6057	mg/kg	(B+T)/FC	0.000125145	BFT-401-3	804400	ug/mL	101
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	E+X	14.3	mg/kg	(E+X)/FC	0.002954545	BFT-401-3	804400	ug/mL	2377
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	B/T	0.0816071		(B/T)/FC	1.6861E-05	BFT-401-3	804400	ug/mL	14
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	B/E	0.0136418		(B/E)/FC	2.81855E-06	BFT-401-3	804400	ug/mL	2
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	B/X	0.0041735		(B/X)/FC	8.62297E-07	BFT-401-3	804400	ug/mL	1
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	T/E	0.1671642		(T/E)/FC	3.45381E-05	BFT-401-3	804400	ug/mL	28
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	T/X	0.0511416		(T/X)/FC	1.05664E-05	BFT-401-3	804400	ug/mL	8
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	E/X	0.3059361		(E/X)/FC	6.32099E-05	BFT-401-3	804400	ug/mL	51
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	(B+T)/(E+X)	0.0423566		((B+T)/(E+X))/FC	8.75137E-06	BFT-401-3	804400	ug/mL	7
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	Fuel Carbon	4840	mg/kg	Fuel Carbon	1	BFT-401-3	804400	ug/mL	804400
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	1,2,3-Trimethylbenzene	20.6	mg/kg	1,2,3 TMB/FC	0.004256198	BFT-401-3	804400	ug/mL	3424
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	1,2,4-Trimethylbenzene	33.4	mg/kg	1,2,4 TMB/FC	0.006900826	BFT-401-3	804400	ug/mL	5551
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	1,3,5-Trimethylbenzene	9.58	mg/kg	1,3,5 TMB/FC	0.001979339	BFT-401-3	804400	ug/mL	1592
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	1-MethylNaphthalene	20.5	mg/kg	1-MN/FC	0.004235537	BFT-401-3	804400	ug/mL	3407
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB1-4'	2-MethylNaphthalene	27.4	mg/kg	2-MN/FC	0.005661157	BFT-401-3	804400	ug/mL	4554
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	Benzene	0.375	mg/kg	B/FC	1.84729E-05	BFT-401-3	804400	ug/mL	15
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	Toluene	0.382	mg/kg	T/FC	1.88177E-05	BFT-401-3	804400	ug/mL	15
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	Ethylbenzene	15.3	mg/kg	E/FC	0.000753695	BFT-401-3	804400	ug/mL	606
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	m-Xylene	22.9	mg/kg	m-Xylene/FC	0.001128079	BFT-401-3	804400	ug/mL	907
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	o-Xylene	13.7	mg/kg	o-Xylene/FC	0.000674877	BFT-401-3	804400	ug/mL	543
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	p-Xylene	8.94	mg/kg	p-Xylene/FC	0.000440394	BFT-401-3	804400	ug/mL	354
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	Total Xylenes (m,p, and o)	45.54	mg/kg	X/FC	0.00224335	BFT-401-3	804400	ug/mL	1805
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	Total BTEX	61.59	mg/kg	BTEX/FC	0.003034335	BFT-401-3	804400	ug/mL	2441
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	B+T	0.757	mg/kg	(B+T)/FC	3.72906E-05	BFT-401-3	804400	ug/mL	30
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	E+X	60.84	mg/kg	(E+X)/FC	0.002997044	BFT-401-3	804400	ug/mL	2411
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	B/T	0.9816754		(B/T)/FC	4.83584E-05	BFT-401-3	804400	ug/mL	39
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	B/E	0.0245098		(B/E)/FC	1.20738E-06	BFT-401-3	804400	ug/mL	1
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	B/X	0.0082345		(B/X)/FC	4.05641E-07	BFT-401-3	804400	ug/mL	0
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	T/E	0.0249673		(T/E)/FC	1.22992E-06	BFT-401-3	804400	ug/mL	1
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	T/X	0.0083882		(T/X)/FC	4.13213E-07	BFT-401-3	804400	ug/mL	0
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	E/X	0.3359684		(E/X)/FC	1.65502E-05	BFT-401-3	804400	ug/mL	13
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	(B+T)/(E+X)	0.0124425		((B+T)/(E+X))/FC	6.1293E-07	BFT-401-3	804400	ug/mL	0
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	Fuel Carbon	20300	mg/kg	Fuel Carbon	1	BFT-401-3	804400	ug/mL	804400
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	1,2,3-Trimethylbenzene	95.5	mg/kg	1,2,3 TMB/FC	0.004704433	BFT-401-3	804400	ug/mL	3784
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	1,2,4-Trimethylbenzene	148	mg/kg	1,2,4 TMB/FC	0.00729064	BFT-401-3	804400	ug/mL	5865
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	1,3,5-Trimethylbenzene	43.5	mg/kg	1,3,5 TMB/FC	0.002142857	BFT-401-3	804400	ug/mL	1724
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	1-MethylNaphthalene	87.3	mg/kg	1-MN/FC	0.004300493	BFT-401-3	804400	ug/mL	3459
NRMRL	JP-5	6/1/90	5/19/97	Tank Farm C, Beaufort MCAS, SC	Soil	BUTFC-SB2-3.5'	2-MethylNaphthalene	115	mg/kg	2-MN/FC	0.005665025	BFT-401-3	804400	ug/mL	4557
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	Benzene	3.25	mg/kg	B/FC	0.000770142	ASSUMEdens	804400	ug/mL	620
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	Toluene	0.0786	mg/kg	T/FC	1.86256E-05	ASSUMEdens	804400	ug/mL	15
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	Ethylbenzene	23.9	mg/kg	E/FC	0.005663507	ASSUMEdens	804400	ug/mL	4556
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	m-Xylene	0.006	mg/kg	m-Xylene/FC	1.4218E-06	ASSUMEdens	804400	ug/mL	1
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	o-Xylene	0.0812	mg/kg	o-Xylene/FC	1.92417E-05	ASSUMEdens	804400	ug/mL	15
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	p-Xylene	0.006	mg/kg	p-Xylene/FC	1.4218E-06	ASSUMEdens	804400	ug/mL	1
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	Total Xylenes (m,p, and o)	0.0932	mg/kg	X/FC	2.20853E-05	ASSUMEdens	804400	ug/mL	18
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	Total BTEX	27.3218	mg/kg	BTEX/FC	0.00647436	ASSUMEdens	804400	ug/mL	5208
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	B+T	3.3286	mg/kg	(B+T)/FC	0.000788768	ASSUMEdens	804400	ug/mL	634
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	E+X	23.9932	mg/kg	(E+X)/FC	0.005685592	ASSUMEdens	804400	ug/mL	4573
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	B/T	41.348601		(B/T)/FC	0.009798247	ASSUMEdens	804400	ug/mL	7882
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	B/E	0.1359833		(B/E)/FC	3.22235E-05	ASSUMEdens	804400	ug/mL	26
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	B/X	34.871245		(B/X)/FC	0.008263328	ASSUMEdens	804400	ug/mL	6647
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	T/E	0.0032887		(T/E)/FC	7.79313E-07	ASSUMEdens	804400	ug/mL	1

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	T/X	0.8433476		(T/X)/FC	0.000199845	ASSUMEdens	804400	ug/mL	161
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	E/X	256.43777		(E/X)/FC	0.060767244	ASSUMEdens	804400	ug/mL	48881
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	(B+T)/(E+X)	0.138731		((B+T)/(E+X))/FC	3.28746E-05	ASSUMEdens	804400	ug/mL	26
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	Fuel Carbon	4220	mg/kg	Fuel Carbon	1	ASSUMEdens	804400	ug/mL	804400
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	1,2,3-Trimethylbenzene	28	mg/kg	1,2,3 TMB/FC	0.006635071	ASSUMEdens	804400	ug/mL	5337
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	1,2,4-Trimethylbenzene	0.287	mg/kg	1,2,4 TMB/FC	6.80095E-05	ASSUMEdens	804400	ug/mL	55
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	1,3,5-Trimethylbenzene	[illegible]	mg/kg	1,3,5 TMB/FC	3.31754E-06	ASSUMEdens	804400	ug/mL	3
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	1-MethylNaphthalene	29.8	mg/kg	1-MN/FC	0.00706161	ASSUMEdens	804400	ug/mL	5680
NRMRL	JP-5	6/1/74	5/19/97	Day Tank 865, Beaufort MCAS, SC	Soil	BUDTSB-3.5'	2-MethylNaphthalene	44.3	mg/kg	2-MN/FC	0.01049763	ASSUMEdens	804400	ug/mL	8444
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	Benzene	0.953	mg/kg	B/FC	3.32056E-05	CEF-293-9FP	799000	ug/mL	27
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	Toluene	17.2	mg/kg	T/FC	0.000599303	CEF-293-9FP	799000	ug/mL	479
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	Ethylbenzene	141	mg/kg	E/FC	0.004912892	CEF-293-9FP	799000	ug/mL	3925
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	m-Xylene	233	mg/kg	m-Xylene/FC	0.008118467	CEF-293-9FP	799000	ug/mL	6487
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	o-Xylene	32.8	mg/kg	o-Xylene/FC	0.001142857	CEF-293-9FP	799000	ug/mL	913
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	p-Xylene	114	mg/kg	p-Xylene/FC	0.003972125	CEF-293-9FP	799000	ug/mL	3174
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	Total Xylenes (m,p, and o)	379.8	mg/kg	X/FC	0.013233449	CEF-293-9FP	799000	ug/mL	10574
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	Total BTEX	538.953	mg/kg	BTEX/FC	0.01877885	CEF-293-9FP	799000	ug/mL	15004
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	B+T	18.153	mg/kg	(B+T)/FC	0.000632509	CEF-293-9FP	799000	ug/mL	505
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	E+X	520.8	mg/kg	(E+X)/FC	0.018146341	CEF-293-9FP	799000	ug/mL	14499
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	B/T	0.055407		(B/T)/FC	1.93056E-06	CEF-293-9FP	799000	ug/mL	2
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	B/E	0.0067589		(B/E)/FC	2.35501E-07	CEF-293-9FP	799000	ug/mL	0
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	B/X	0.0025092		(B/X)/FC	8.74291E-08	CEF-293-9FP	799000	ug/mL	0
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	T/E	0.1219858		(T/E)/FC	4.25038E-06	CEF-293-9FP	799000	ug/mL	3
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	T/X	0.045287		(T/X)/FC	1.57794E-06	CEF-293-9FP	799000	ug/mL	1
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	E/X	0.371248		(E/X)/FC	1.29355E-05	CEF-293-9FP	799000	ug/mL	10
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	(B+T)/(E+X)	0.034856		((B+T)/(E+X))/FC	1.21449E-06	CEF-293-9FP	799000	ug/mL	1
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	Fuel Carbon	28700	mg/kg	Fuel Carbon	1	CEF-293-9FP	799000	ug/mL	799000
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	1,2,3-Trimethylbenzene	88.4	mg/kg	1,2,3 TMB/FC	0.003080139	CEF-293-9FP	799000	ug/mL	2461
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	1,2,4-Trimethylbenzene	210	mg/kg	1,2,4 TMB/FC	0.007317073	CEF-293-9FP	799000	ug/mL	5846
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	1,3,5-Trimethylbenzene	86.3	mg/kg	1,3,5 TMB/FC	0.003006969	CEF-293-9FP	799000	ug/mL	2403
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	1-MethylNaphthalene	84.3	mg/kg	1-MN/FC	0.002937282	CEF-293-9FP	799000	ug/mL	2347
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB1-8.5'	2-MethylNaphthalene	133	mg/kg	2-MN/FC	0.00463414	CEF-293-9FP	799000	ug/mL	3703
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	Benzene	0.976	mg/kg	B/FC	3.35395E-05	CEF-293-9FP	799000	ug/mL	27
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	Toluene	19.1	mg/kg	T/FC	0.000656357	CEF-293-9FP	799000	ug/mL	524
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	Ethylbenzene	155	mg/kg	E/FC	0.00532646	CEF-293-9FP	799000	ug/mL	4256
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	m-Xylene	263	mg/kg	m-Xylene/FC	0.009037801	CEF-293-9FP	799000	ug/mL	7221
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	o-Xylene	37.4	mg/kg	o-Xylene/FC	0.001285223	CEF-293-9FP	799000	ug/mL	1027
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	p-Xylene	125	mg/kg	p-Xylene/FC	0.004295533	CEF-293-9FP	799000	ug/mL	3432
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	Total Xylenes (m,p, and o)	425.4	mg/kg	X/FC	0.014618557	CEF-293-9FP	799000	ug/mL	11680
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	Total BTEX	600.476	mg/kg	BTEX/FC	0.020634914	CEF-293-9FP	799000	ug/mL	16487
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	B+T	20.076	mg/kg	(B+T)/FC	0.000689897	CEF-293-9FP	799000	ug/mL	551
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	E+X	580.4	mg/kg	(E+X)/FC	0.019945017	CEF-293-9FP	799000	ug/mL	15936
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	B/T	0.0510995		(B/T)/FC	1.756E-06	CEF-293-9FP	799000	ug/mL	1
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	B/E	0.0062968		(B/E)/FC	2.16384E-07	CEF-293-9FP	799000	ug/mL	0
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	B/X	0.0022943		(B/X)/FC	7.88423E-08	CEF-293-9FP	799000	ug/mL	0
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	T/E	0.1232258		(T/E)/FC	4.23456E-06	CEF-293-9FP	799000	ug/mL	3
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	T/X	0.0448989		(T/X)/FC	1.54292E-06	CEF-293-9FP	799000	ug/mL	1
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	E/X	0.364363		(E/X)/FC	1.25211E-05	CEF-293-9FP	799000	ug/mL	10
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	(B+T)/(E+X)	0.0345899		((B+T)/(E+X))/FC	1.18866E-06	CEF-293-9FP	799000	ug/mL	1
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	Fuel Carbon	29100	mg/kg	Fuel Carbon	1	CEF-293-9FP	799000	ug/mL	799000
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	1,2,3-Trimethylbenzene	99.8	mg/kg	1,2,3 TMB/FC	0.003429553	CEF-293-9FP	799000	ug/mL	2740
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	1,2,4-Trimethylbenzene	238	mg/kg	1,2,4 TMB/FC	0.008178694	CEF-293-9FP	799000	ug/mL	6535
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	1,3,5-Trimethylbenzene	96.9	mg/kg	1,3,5 TMB/FC	0.003329897	CEF-293-9FP	799000	ug/mL	2661
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	1-MethylNaphthalene	94.4	mg/kg	1-MN/FC	0.003243986	CEF-293-9FP	799000	ug/mL	2592
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB11-8.5'	2-MethylNaphthalene	150	mg/kg	2-MN/FC	0.005154639	CEF-293-9FP	799000	ug/mL	4119
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	Benzene	0.012	mg/kg	B/FC	3.64742E-06	ASSUMEdens	799000	ug/mL	3
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	Toluene	0.208	mg/kg	T/FC	6.32219E-05	ASSUMEdens	799000	ug/mL	51
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	Ethylbenzene	1.47	mg/kg	E/FC	0.000446809	ASSUMEdens	799000	ug/mL	357
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	m-Xylene	3.26	mg/kg	m-Xylene/FC	0.000990881	ASSUMEdens	799000	ug/mL	792
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	o-Xylene	0.666	mg/kg	o-Xylene/FC	0.000202432	ASSUMEdens	799000	ug/mL	162

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	p-Xylene	1.31	mg/kg	p-Xylene/FC	0.000398176	ASSUMEdens	799000	ug/mL	318
NRMRL	JP 5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	Total Xylenes (m,p, and o)	5.236	mg/kg	X/FC	0.001591489	ASSUMEdens	799000	ug/mL	1272
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	Total BTEX	6.926	mg/kg	BTEX/FC	0.002105167	ASSUMEdens	799000	ug/mL	1682
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	B+T	0.22	mg/kg	(B+T)/FC	6.68693E-05	ASSUMEdens	799000	ug/mL	53
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	E+X	6.706	mg/kg	(E+X)/FC	0.002038298	ASSUMEdens	799000	ug/mL	1629
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	B/T	0.0576923		(B/T)/FC	1.75357E-05	ASSUMEdens	799000	ug/mL	14
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	B/E	0.0081633		(B/E)/FC	2.48124E-06	ASSUMEdens	799000	ug/mL	2
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	B/X	0.0022918		(B/X)/FC	6.96604E-07	ASSUMEdens	799000	ug/mL	1
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	T/E	0.1414966		(T/E)/FC	4.30081E-05	ASSUMEdens	799000	ug/mL	34
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	T/X	0.039725		(T/X)/FC	1.20745E-05	ASSUMEdens	799000	ug/mL	10
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	E/X	0.2807487		(E/X)/FC	8.53339E-05	ASSUMEdens	799000	ug/mL	68
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	(B+T)/(E+X)	0.0328064		((B+T)/(E+X))/FC	9.97156E-06	ASSUMEdens	799000	ug/mL	8
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	Fuel Carbon	3290	mg/kg	Fuel Carbon	1	ASSUMEdens	799000	ug/mL	799000
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	1,2,3-Trimethylbenzene	13.9	mg/kg	1,2,3 TMB/FC	0.004224924	ASSUMEdens	799000	ug/mL	3376
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	1,2,4-Trimethylbenzene	21.5	mg/kg	1,2,4 TMB/FC	0.006534954	ASSUMEdens	799000	ug/mL	5221
NRMRL	JP-5	6/1/81	5/20/97	Facility [illegible] Cecil Field NAS, FL	Soil	CFSB3-8.5'	1,3,5-Trimethylbenzene	7.05	mg/kg	1,3,5 TMB/FC	0.002142857	ASSUMEdens	799000	ug/mL	1712
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	1-MethylNaphthalene	16.4	mg/kg	1-MN/FC	0.004984802	ASSUMEdens	799000	ug/mL	3983
NRMRL	JP-5	6/1/81	5/20/97	Facility 293, Cecil Field NAS, FL	Soil	CFSB3-8.5'	2-MethylNaphthalene	25.5	mg/kg	2-MN/FC	0.00775076	ASSUMEdens	799000	ug/mL	6193

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-8	12/1/95	3/10/98	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJ98-SB2-4	1,3,5-Trimethylbenzene	48.6	mg/kg	1,3,5 TMB/FC	0.002103896	SJ98-MP2	812000	ug/mL	1708
NRMRL	JP-8	12/1/95	3/10/98	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJ98-SB2-4	1-MethylNaphthalene	60.4	mg/kg	1-MN/FC	0.002614719	SJ98-MP2	812000	ug/mL	2123
NRMRL	JP-8	12/1/95	3/10/98	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJ98-SB2-4	2-MethylNaphthalene	87.2	mg/kg	2-MN/FC	0.003774892	SJ98-MP2	812000	ug/mL	3065
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	Benzene	10.8	mg/kg	B/FC	0.000486486	SJMW1SFP	793000	ug/mL	386
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	Toluene	64.7	mg/kg	T/FC	0.002914414	SJMW1SFP	793000	ug/mL	2311
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	Ethylbenzene	56.1	mg/kg	E/FC	0.002527027	SJMW1SFP	793000	ug/mL	2004
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	m-Xylene	152	mg/kg	m-Xylene/FC	0.006846847	SJMW1SFP	793000	ug/mL	5430
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	o-Xylene	86.7	mg/kg	o-Xylene/FC	0.00390540[illegible]	SJMW1SFP	793000	ug/mL	3097
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	p-Xylene	53.6	mg/kg	p-Xylene/FC	0.002414414	SJMW1SFP	793000	ug/mL	1915
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	Total Xylenes (m,p, and o)	292.3	mg/kg	X/FC	0.013166667	SJMW1SFP	793000	ug/mL	10441
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	Total BTEX	423.9	mg/kg	BTEX/FC	0.019094595	SJMW1SFP	793000	ug/mL	15142
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	B+T	75.5	mg/kg	(B+T)/FC	0.003400901	SJMW1SFP	793000	ug/mL	2697
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	E+X	348.4	mg/kg	(E+X)/FC	0.015693694	SJMW1SFP	793000	ug/mL	12445
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	B/T	0.1669243		(B/T)/FC	7.51911E-06	SJMW1SFP	793000	ug/mL	6
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	B/E	0.1925134		(B/E)/FC	8.67177E-06	SJMW1SFP	793000	ug/mL	7
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	B/X	0.0369483		(B/X)/FC	1.66434E-06	SJMW1SFP	793000	ug/mL	1
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	T/E	1.1532977		(T/E)/FC	5.19503E-05	SJMW1SFP	793000	ug/mL	41
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	T/X	0.2213479		(T/X)/FC	9.97063E-06	SJMW1SFP	793000	ug/mL	8
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	E/X	0.1919261		(E/X)/FC	8.64532E-06	SJMW1SFP	793000	ug/mL	7
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	(B+T)/(E+X)	0.2167049		((B+T)/(E+X))/FC	9.76148E-06	SJMW1SFP	793000	ug/mL	8
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	Fuel Carbon	22200	mg/kg	Fuel Carbon	1	SJMW1SFP	793000	ug/mL	793000
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	1,2,3-Trimethylbenzene	[illegible]	mg/kg	1,2,3 TMB/FC	[illegible]36036	SJMW1SFP	793000	ug/mL	4251
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	1,2,4-Trimethylbenzene	269	mg/kg	1,2,4 TMB/FC	0.012117117	SJMW1SFP	793000	ug/mL	9609
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	1,3,5-Trimethylbenzene	102	mg/kg	1,3,5 TMB/FC	0.004594595	SJMW1SFP	793000	ug/mL	3644
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	1-MethylNaphthalene	62.4	mg/kg	1-MN/FC	0.002810811	SJMW1SFP	793000	ug/mL	2229
NRMRL	JP-8	12/1/95	5/14/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB1-5.5'	2-MethylNaphthalene	96.9	mg/kg	2-MN/FC	0.004364865	SJMW1SFP	793000	ug/mL	3461
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	Benzene	12.5	mg/kg	B/FC	0.000313283	SJMW1SFP	793000	ug/mL	248
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	Toluene	56.3	mg/kg	T/FC	0.001411028	SJMW1SFP	793000	ug/mL	1119
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	Ethylbenzene	75.3	mg/kg	E/FC	0.001887[illegible]	SJMW1SFP	793000	ug/mL	1497
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	m-Xylene	217	mg/kg	m-Xylene/FC	0.005438596	SJMW1SFP	793000	ug/mL	4313
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	o-Xylene	124	mg/kg	o-Xylene/FC	0.003107769	SJMW1SFP	793000	ug/mL	2464
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	p-Xylene	75.4	mg/kg	p-Xylene/FC	0.001889724	SJMW1SFP	793000	ug/mL	1499
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	Total Xylenes (m,p, and o)	416.4	mg/kg	X/FC	0.01043609	SJMW1SFP	793000	ug/mL	8276
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	Total BTEX	560.5	mg/kg	BTEX/FC	0.014047619	SJMW1SFP	793000	ug/mL	11140
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	B+T	68.8	mg/kg	(B+T)/FC	0.001724311	SJMW1SFP	793000	ug/mL	1367
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	E+X	491.7	mg/kg	(E+X)/FC	0.012323308	SJMW1SFP	793000	ug/mL	9772
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	B/T	0.2220249		(B/T)/FC	5.56453E-06	SJMW1SFP	793000	ug/mL	4
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	B/E	0.1660027		(B/E)/FC	4.16047E-06	SJMW1SFP	793000	ug/mL	3
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	B/X	0.0300192		(B/X)/FC	7.52361E-07	SJMW1SFP	793000	ug/mL	1
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	T/E	0.747676		(T/E)/FC	1.87387E-05	SJMW1SFP	793000	ug/mL	15
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	T/X	0.1352065		(T/X)/FC	3.38863E-06	SJMW1SFP	793000	ug/mL	3
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	E/X	0.1808357		(E/X)/FC	4.53222E-06	SJMW1SFP	793000	ug/mL	4
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	(B+T)/(E+X)	0.1399227		((B+T)/(E+X))/FC	3.50684E-06	SJMW1SFP	[illegible]	ug/mL	[illegible]
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	Fuel Carbon	39900	mg/kg	Fuel Carbon	1	SJMW1SFP	793000	ug/mL	793000
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	1,2,3-Trimethylbenzene	208	mg/kg	1,2,3 TMB/FC	0.005213033	SJMW1SFP	793000	ug/mL	4134
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	1,2,4-Trimethylbenzene	434	mg/kg	1,2,4 TMB/FC	0.010877193	SJMW1SFP	793000	ug/mL	8626
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	1,3,5-Trimethylbenzene	156	mg/kg	1,3,5 TMB/FC	0.003909774	SJMW1SFP	793000	ug/mL	3100
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	1-MethylNaphthalene	113	mg/kg	1-MN/FC	0.00283208	SJMW1SFP	793000	ug/mL	2246
NRMRL	JP-8	12/1/95	5/15/97	Bldg 4522, Seymour Johnson AFB, SC	Soil	SJSB2-5.5'	2-MethylNaphthalene	172	mg/kg	2-MN/FC	0.004310777	SJMW1SFP	793000	ug/mL	3418
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	Benzene	11.4	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	Toluene	32.5	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	Ethylbenzene	32.2	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	m-Xylene	68.9	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	o-Xylene	43.1	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	p-Xylene	24.5	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	Total Xylenes (m,p, and o)	136.5	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	Total BTEX	212.6	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	B+T	43.9	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	E+X	168.7	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	B/T	0.3507692							no FC data

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	B/E	0.3540373							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	B/X	0.0835165							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	T/E	1.0093168							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	T/X	0.2380952							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	E/X	0.2358974							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	(B+T)/(E+X)	0.2602253							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	1,2,3-Trimethylbenzene	56.4	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	1,2,4-Trimethylbenzene	129	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	1,3,5-Trimethylbenzene	48.2	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	1-MethylNaphthalene	26.4	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 1	2-MethylNaphthalene	42	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	Benzene	11.1	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	Toluene	78.6	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	Ethylbenzene	64.2	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	m-Xylene	115	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	o-Xylene	72.4	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	p-Xylene	45.7	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	Total Xylenes (m,p, and o)	233.1	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	Total BTEX	387	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	B+T	89.7	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	E+X	297.3	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	B/T	0.1412214							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	B/E	0.1728972							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	B/X	0.047619							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	T/E	1.2242991							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	T/X	0.3371943							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	E/X	0.2754183							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	(B+T)/(E+X)	0.3017154							no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	1,2,3-Trimethylbenzene	57.2	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	1,2,4-Trimethylbenzene	141	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	1,3,5-Trimethylbenzene	50.6	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	1-MethylNaphthalene	33.4	mg/kg						no FC data
NRMRL	JP-8	12/1/95	7/19/96	Bldg 4522, Seymour Johnson AFB, SC	Soil	Soil Sample 2	2-MethylNaphthalene	48.3	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	Benzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	Toluene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	Ethylbenzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	m-Xylene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	o-Xylene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	p-Xylene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	Total Xylenes (m,p, and o)	0.018	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	Total BTEX	0.036	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	B+T	0.012	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	E+X	0.024	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	B/T	1							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	B/E	1							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	B/X	0.3333333							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	T/E	1							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	T/X	0.3333333							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	E/X	0.3333333							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	(B+T)/(E+X)	0.5							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	1,2,3-Trimethylbenzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	1,2,4-Trimethylbenzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	1,3,5-Trimethylbenzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	1-MethylNaphthalene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	7POP2	2-MethylNaphthalene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	Benzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	Toluene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	Ethylbenzene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	m-Xylene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	o-Xylene	0.006	mg/kg						no FC data

Lab Code	Fuel Type	Spill Date	Date	Site Name	Matix	Locid	Analyte	Results	Units	FC Analyte	FC Ratio	FPLocid	FPdensity	FPunits	SoilFuel (ug/mL)
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	p-Xylene	0.006	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	Total Xylenes (m,p, and o)	0.018	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	Total BTEX	0.036	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	B+T	0.012	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	E+X	0.024	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	B/T	1							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	B/E	1							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	B/X	0.3333333							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	T/E	1							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	T/X	0.3333333							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	E/X	0.3333333							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	(B+T)/(E+X)	0.5							no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	1,2,3-Trimethylbenzene	0.147	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	1,2,4-Trimethylbenzene	0.219	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	1,3,5-Trimethylbenzene	0.0911	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	1-MethylNaphthalene	0.239	mg/kg						no FC data
NRMRL	JP-8	4/1/96	7/19/96	JP-8 Release Site, Pope AFB, NC	Soil	9POP2	2-MethylNaphthalene	0.323	mg/kg						no FC data